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L7: Entry 7 of 112 File: USPT Jul 31, 2001

DOCUMENT-IDENTIFIER: US 6269356 B1
TITLE: Computer system program for creating new ideas and solving problems

ABPL:
A computerized idea generator and problem solver that can receive English language sentences describing a problem to be solved and generate solutions by analogy. The computer uses words in the problem description sentences to obtain information from a database that relates to the type of problem to be solved, for example, animal, plant or human. The computer then uses this information to access analogous information from a second database. The information used can include (1) where a noun in the problem description is categorized in a hierarchy of information within the database, and (2) what purpose or what function is provided by that noun. This information is used to obtain a noun from a second database and a description of how to solve an analogous problem with respect to that noun. The original noun is substituted in the sentence for the second noun to arrive at a solution.

BSPR:
Expert systems are computer systems that are used to store large amounts of information on a particular topic in a computer database and are designed to respond to queries from a user to provide information about a particular problem. For example, there are expert systems that are used to guide boats through a harbor. Such an expert system contains information in a database that relates to the heights of bridges and the depths of channels in the harbor. A user can query this system on what route it should take with a boat having certain dimensions.

BSPR:
In particular, in one embodiment of the invention, a computer program receives an input statement including a description of the problem and a goal statement. For example, "The beavers destroyed the bark. Save the tree." The computer program determines that the word "bark" represents an object of the verb repair, which is associated with the word "save" in the problem statement. The computer program then looks up the work "bark" in the tree Experience Database. The program determines that the "bark" entry in the tree Experience Database is at the second hierarchical level in the data base and that its function is to "protect" the tree. The program also finds that the tree Experience Database has no "repair" function for bark. The computer program then consults a second data base, for example the human Experience Database. It looks for an entry at the second hierarchical level whose function is to "protect" the human, which is the entry corresponding to "skin". The computer program locates the entry in the human Experience Database that corresponds to the repair function for skin: "Transplant skin to damaged location." The program then substitutes the word "bark" for the word "skin" in the above sentence to result in a solution to the problem: "Transplant bark to damaged location." This solution can then be stored in the tree Experience Database so that if the same problem arises again the computer program will not have to create the solution a second time.

BSPR:
This invention is a high level computer program that can create new ideas and solve a broad range of problems. It does this through the word analysis of a user inputted problem statement (an English sentence) and a goal declaration (most often a verb phrase). The computer program analyzes the problem statement and goal declaration looking for key words that fall into the classification of: an Action Maker (subject); an Action (primary verb); and Action Taker (object). Each word (either subject or object) is referenced to dictionary data which has been previously categorized. For example, the word bark is in the plant category and

further divided into the sub category of tree.

BSPR:
A section in the computer program looks at the input information (problem statement and goal declaration) to see if it fits the logic of the world in terms of create and destroys since most things in the world eventually fit into these categories--things are created and then, over time, erode back to the material that created them.

BSPR:
This invention provides a system to emulate human creativity and the human problem solving process using a defined "solution processor" as disclosed in this application, and "Experience Databases." An "Experience Database" is a description of any system in the universe formatted as a hierarchical data structure. The tree system (called the tree Experience Database) is shown in FIG. 1 and 3 in this document. FIG. 3 is a partial listing for category "plant" and subcategory tree. It defines the functions of a tree starting at level one. Tree has four level one functions which are all defined as the first argument of one, namely, branch, trunk, root, and nutrient. The process "branch", for example, performs the function [hold,branch,leaf]. The verb "hold" relates branch and leaf. It is read as "branch hold leaf." Any analogy search would look at selected "holds" (based on program logic analysis) to determine if the arguments of this "hold" could be substituted to solve a problem or create a new idea. FIG. 1 details the same information as in FIG. 3, but is shown in a pictorial format. The "Experience Databases" act like real human experience and allow the system disclosed to act in a way that, by adding more "Experience Databases," the system increases its ability to suggest ideas and find solutions.

DEPR:
The key component to this general purpose problem solving system lies in the "Experience Databases". (See FIGS. 1 and 2.) This is new and novel and ties together this system's unique ability to generate ideas or solve any problem using these database structures and the search processes employed in this software program. From the logical analysis of the input statements, the program decides which "Experience Database" to search to find its answers. The search mechanism within this software program must have databases organized in such a way that it lends itself to the selection of the appropriate answer(s). The database is organized based on actions or verbs that tie all the nouns together in the world - this tying together of all the nouns by verbs is done by a hierarchical system of databases for each category. For example, tree is a sub category of category plant and the beaver tree problem is solved, in part, by using the tree.exp database. What causes analogy to serve as a basis for problem solving is predicated on the fact that all systems in the universe form under some sort of force. Across each system as in plants and animals is the common forces of nature. In the case of plants and animals, as one example, you would have the force that causes each system to protect (verb) itself against the force of weather. The protective device is bark and skin respectively. In the case of the "beaver tree problem" (as it will be referred to throughout this document) each system, plant and animals alike, are forced to develop similarly. These similarities are apparent if one were to break down plants and animals (in this case) in a hierarchical structure using functions and processes. In FIG. 1--tree.exp, a tree has a function called "support(trunk,bark)." It is made of a process called "protect(bark,tree)" and others that are not shown. Likewise, in FIG. 2--human.exp, a human has a function called "perform(organ,function)" and has as one of its processes a function called "protect(skin,human)." These two functions: "protect(bark,tree)" and "protect(skin,human)" occur at level 2 in the hierarchy for both the ("Tree.exp",plant) and ("human.exp" ,animal") "Experience Databases." The format for any level in an "Experience Database" is:

DEPR:
In summary and up to this point, we were given the information that a beaver destroyed (removed) the bark from around the base of a tree. If gone untreated, the tree would die. An idea was tried and strips of bark (grafting) were placed across the area of removed bark which proved to be a method to save the tree from dying. The method by which this problem was solved, using some theories on the structures of systems and the way the human brain may solve problems, was implemented in a computer software program. Part of the way the software program goes about solving this problem is by analysis of the problem statement (The beaver destroyed the bark) and the goal declaration statement (Save the tree).

There is a lot of sentence processing by the software program, but it eventually leads to the "Experience Databases" for plants and animals. It focuses in on two key parts of the Experience data and starts by isolating this information in the plant "Experience Database" (tree.exp) and homing in on the function identified as "protect(bark,tree)." It then looks for the "protect" verb in the (human.exp) database and finds "protect(skin,human)" noting that this also occurs at Level 2 in the hierarchy. (See FIGS. 1 and 2.) The software program will now assume that "bark" and "skin" are analogous (because of the pointer verb "protect" and because they are both at the same level in their respective "Experience Databases") and begin a search in the (human.exp) database looking for a repair function for skin (because the software program knows bark was destroyed and it must be repaired by the goal declaration: Save the tree). (Also note that the software program knows that "bark" in the problem statement and "tree" in the goal declaration come for the same category "plant" as defined in dictionary of this system.) When it finds a repair function in the "human.exp" database for skin (see FIG. 4B--data item starting with three ([repair,skin . . . , it will substitute bark for skin (because of the common verb "protect") and solves the "beaver tree problem" by suggesting:

DEPR:
Note that the word beaver in item 7C above has been changed from cn to cnp. Since all words in the dictionary are singular (nouns), beaver was changed to cnp (common noun plural) to reflect the word "beavers" in the problem statement--see line item 1A above. The dictionary words have three main purposes in solving problems. First, it is important for the system to identify each word Category. For example, the word bark is identified as Category "plant" as defined by the dictionary--see 4C above. The system must know this because it will go to the ("tree.exp", plant) "Experience database"--(FIG. 3) and begin to look through the hierarchical statements beginning at level 0 (first entry is: zero([environment, tree],[0],[living, physical,organism]) looking for the word "bark" where "physical" is now. This does occur within (FIG. 3) at level 2 and is identified as:

DEPR:
The problem and goal declaration statements are broken down into Action_Maker, Action, and Action_Taker (see 26A, 27A, 28A, 29A, and 30A above) by the computer program. These then become the lowest common denominator in all problem and goal declaration statements, and allow the computer program to process similar problem and goal declaration statements in the same fashion so as to guarantee the same results (answers). It further identifies who (noun subject) caused the action and who (noun object) received the action. Time and state verbs are discounted as not having a legitimate place in the interaction between nouns because its more difficult to describe any changes to noun subject or object. It is certainly possible to include rules (in the current computer program) that would account for any effect they may have on nouns. In general, adjectives and adverbs are also currently discounted, but in a rule based system, as this one is, it's relatively easy to add rules to address their effect on nouns, pronouns, and verbs.

DEPR:
The "semantic logic system" transfers two important pieces of information to the "database search and logic system." The first is the "search list" and the second is the "seed word" based on the semantic analysis of the problem and goal declaration statements for the "beaver tree problem." The "database search and logic system" isolates the word "bark" knowing that the "semantic logic system" defined it as the Action_Taker in the problem statement based on analysis of the problem and goal declaration statements. The "database search and logic system" begins a search through the "tree.exp" database looking for the bark function and finds "protect(bark,tree)". (See FIG. 1.) It then stores the list of words (protect,bark,tree] and uses the word "protect" as the analogy word for the next database search. The next database search has been defined by the "semantic logic system" in its analysis of the "beaver tree problem." It passes the "search list" that contains its guesses of other "Experience Databases" to search for the analogy to "protect." It begins its search in the "human.exp" (experience) database looking at level 2 in the hierarchy and finds "protect(skin,human)." At this point, the computer program displays the following information to the user on the CRT:

DEPR:

Based on prior analysis by the "semantic logic system" the "database search and logic system" looks for a "skin repair" function within the "human.exp" database that relates skin and repair. It finds one (See FIG. 4B level 3):

DEPL:
Level_in_hierarchy([Child,Parent],[Numeric_Level_in hierarchy],[Verb,Noun_Subject, Noun_Object]). So for example, "protect(bark,tree)" can be read as "protect(Verb)(bark(Noun_Subject),tree(Noun_Object))" and "protect(skin,human)" as "protect(Verb) (skin(Noun_Subject), human_object)). These can be rewritten to appear more like English sentences as in: "bark protect tree" and "skin protect human." These "Experience Databases" were devised in such a way as to allow the software program to search for answers based on the organization of systems and their likeness to each other. The theory states that if you break up systems in a hierarchical format, as functions and processes, you will find the same verbs at or near the same level in the hierarchy across different "Experience Databases." What this further shows is that the verbs, in this case "protect", can be found in both the "tree.exp" and "human.exp" databases at level 2. This then being the case, it could be said that nature has made nouns (bark and skin) analogous to each other because they are tied together by the common verb protect under the common force of weather. It would further suggest that a solution in a particular system may be applied to another system through its analogies. These analogy substitutions are not just limited to verbs like "protect" being at the same level in a hierarchy, as in FIGS. 1, 2, but also for "protects" that may occur at different levels or within other categories because nature tends to also duplicate functions at different levels across or within the same system as in the plant and animal systems. Note that "protect" is a function and could have many different arguments (nouns). It may be that "protect(paint,car)", in addition to "protect(bark,tree)" and "protect(skin,human)", could be used to solve the "beaver tree problem." What "protects" that gets used by the system to solve problems is determined by the analysis of the problem statement and goal declaration statement.

CLPR:
9. The system of claim 8, further comprising means for determining the hierarchical level of said entry in said first data base and wherein said means for obtaining data from said second data base obtains said data at said hierarchical level in said second data base.

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L7: Entry 9 of 112 File: USPT Jun 26, 2001

DOCUMENT-IDENTIFIER: US 6253064 B1
TITLE: Terminal based traffic management and security surveillance system for aircraft and other commercial vehicles

ABPL:
A traffic management, security and surveillance system for commercial vehicles while in port incorporates a plurality of strategically located sensors for identifying the location of both commercial vehicles and support assets, as well as personnel, for monitoring traffic flow and supporting traffic management of the commercial vehicles, assets and personnel while in the area. The location signals are transmitted to a ground based monitoring and control center and may be archived for later playback. The system also is adapted for utilizing on board location signal generators such as GPS sensors to provide traffic flow information and traffic management of all commercial vehicles, assets and personnel on the system.

PCPR:
This application is a related to my copending applications entitled: Wireless Transducer Data Capture and Retrieval System for Aircraft, Ser. No. 08/745,536, filed on Nov. 12,1996; Video and Data Capture Retrieval Surveillance System for Aircraft, U.S. Ser. No. 08/729,139, filed on Oct. 11, 1996; and Acoustic Catastrophic Event Detection and Data Capture and Retrieval System for Aircraft, U.S. Ser. No. 08/738,487, filed on Oct. 28, 1996 now U.S. Pat. No. 5,798,458, and my copending applications Ground Based Security Surveillance System for Aircraft and Other Commerical Vehicles; Apparatus for and Method of Collecting and Distributing Event Data to Strategic Security Personnel and Response Vehicles; Ground Link with On-Board Security Surveillance System for Aircraft and Other Commercial Vehicles; and, Network Communication Techniques for Security Surveillance and Safety System, filed on even date herewith.

BSPR:
The subject invention is generally related to safety and surveillance equipment for aircraft, ships and other commercial vehicles and is specifically directed to a comprehensive multi-media traffic management and security surveillance system for same while in port or terminal and/or unattended whether taxiing or parked. The system of the subject invention also permits tracking while en route.

BSPR:
Security is of ever increasing importance. This is particularly true with respect to commercial airlines as more and more people and freight are moved in this manner and aircraft and other commercial transports increasingly become the targets of terrorists activities. The airways are becoming increasingly crowded with traffic. Global tracking systems are now in place to monitor the flight of the aircraft from the moment it lifts off until it safely lands at its destination. Radar and navigational positioning systems are commonplace both on the aircraft and at the ground tracking stations. All of these electronic systems have increased the overall safety record of commercial traffic to new standards as the number of miles flown continues to escalate.

BSPR:
In addition, the on board avionics including electronic monitoring and diagnostic equipment, particularly on large commercial jets, continues to evolve, giving both the on board crew and the ground assets more complete, accurate and up to date information regarding the condition of the aircraft while in flight. Flight recorders long have been incorporated in order to provide a record of each flight and in order to provide critical information to aid in the determination of the

causes of an accident or multifinction should one occur.

BSPR:
However, one area which has been neglected with the ever increasing availability of electronic surveillance is the security of the aircraft or other vehicles or vessels, including, but not limited to, over-the-road vehicles, ships and other commercial transports (collectively referred to as commercial transports), particularly when unattended. Typically, when an aircraft is on the ground, or in port, and unattended the only security provided is the security of the location. If the security of the area in which the commercial transport is stored is breached, the commercial transport is an easy target. In most cases, even the access doors are left open and further, for obvious safety reasons, are designed not to be locked from the outside. Many critical areas of the commercial transport are left exposed such as in an aircraft, by way of example, the landing gear, the engine housing and critical wing and tail components.

BSPR:
In addition, most of the ground traffic control relies on pilot visual information and onboard avionics providing an in adequate, at best, traffic management system utilizing already overworked equipment. The limited control and management of terminal traffic including not only the commercial transports, but also ground personnel, security vehicles and fuel trucks and other support vehicles, creates a dangerous and hazardous condition at most highly congested terminals. There are not any monitoring devices to assure that such traffic is in its assigned zones or to alert when a commercial transport is at risk because of breach of a restricted zone by unauthorized personnel or unauthorized vehicles, including overlapping exclusive occupancy zones by more than one commercial transport.

BSPR:
The subject invention is directed to a comprehensive multi-media safety, tracking and/or surveillance system, which in the preferred form provides both visual and/or audio information as well as critical data such as location, direction, intrusion, fire and/or smoke detection and/or status of environmental conditions and/or transport systems status. In my aforementioned patent and copending applications, incorporated herein by reference, detection and sensor systems are utilized to provide the flight crew and/or a ground tracking station for commercial aircraft critical information during flight and/or to record the information and data generated during flight for later reconstruction of catastrophic events. The subject invention is an expansion of this concept and adds not only ground security and surveillance, but tracking while in port or on the ground as well as while in route, as well as incorporating the onboard systems of the aforementioned patent and applications. It is an important feature of the invention that the transmitting network for provides a comprehensive communications link between stationary and mobile stations on the ground, the craft or vehicle being monitored and strategic sensors both onboard the commercial transport and the sensors on the ground. In the preferred embodiment of the invention, a wireless LAN (local area network), WAN (wide area network) or other wireless transmission scheme is used as the transmission system of choice. A digital wireless voice intercom is provided for security purposes and for communication between the onboard crew and the ground based personnel. In the preferred embodiment video intercom is also provided. Digital wireless telecommunication capability provides for text communications. Digital wireless (such as, by way of example, LAN) based file communication capability permits the transmission of information such as route or flight plans or gate and dock information. As an example, a LAN or WAN has worldwide tracking capability adapted to be used in connection with a global satellite communication system such as IRIDIUM, wherein the entire path and status of the commercial transport may be monitored while airborne over satellite connections. While wireless systems provide the preferred form of communication, many features of the invention may be practiced using other communication links within the scope and spirit of the invention.

BSPR:
One important feature of the invention is the ability to remotely monitor a commercial transport while on the ground, whether or not the commercial transport is attended. This will permit detection of unexpected events, breach of security, change in environmental conditions and other activities both on and in the vicinity of the commercial transport. A GPS system may be included to provide

accurate positioning information of the commercial transport, establishing the parked position of the commercial transport at any time, as well as tracking its movements.

BSPR:
Once in port, the system of the subject invention permits complete monitoring of on ground movement, and allows the monitoring of other commercial transport in the area to assure that the various transports do not interfere with one another. This provides collision avoidance, and can be utilized both on the ground and in the air or in route via water or land. Current airborne collision avoidance is accomplished by use of a radar transponder. Aircraft position is located by radar "echo" response and altitude by a "reporting altimeter" reading being returned to the radar system encoded in the transporter return. Use of a satellite based LAN or WAN will provide an "intranet in the sky", providing much more accurate GPS position, altitude, heading, speed and other navigational information to the FAA and other operators and computer tracking and monitoring stations, thus enhancing collision avoidance information.

BSPR:
In its preferred form, a plurality of sensor units, which may include at least one video or image sensor/device and/or at least one audio sensor and/or at least one motion sensor, are placed strategically about the interior and exterior of the commercial transport and at strategic ground based locations. In addition, strategically placed motion detectors, fire sensors, smoke sensors, door or latch sensors and other monitoring equipment are incorporated in the system. A comprehensive system incorporating these various sensing devices provide a broad based, multimedia safety, security and surveillance system for monitoring commercial transports at any time, whether or not attended.

BSPR:
In addition to safety and/or surveillance issues, the comprehensive data collection scheme of the subject invention provides a system permitting enhanced monitoring and/or response to crew generated work orders or re-supply orders, and may even avoid the requirement that the crew order certain supplies. For example, by monitoring the fuel, fresh water, waste water and/or hydraulic levels onboard and transmitting this to a ground station, refueling, water delivery and/or hydraulic fluid check and supply may be initiated by the station crew and prepared for delivery when the commercial transport arrives in port. The performance parameters of the commercial transport may also be monitored and may be utilized for initiating maintenance procedures, for example, even before the commercial transport is in port. Pre-flight or pre-mission checklists may be enhanced or automated by monitoring the critical functions and criteria via the system of the subject invention. The system of the subject invention greatly enhances maintenance procedures and efficiency. Where desired, the system is capable of permitting the commercial transport to carry its detailed maintenance record onboard, permitting full access to such information at remote locations. The maintenance record can be routinely updated or polled from the home based maintenance station using the system's unique uplink capability. The ability to both send and receive information will support remote control of the commercial transport onboard systems such as lighting, strobes, alarm setting/resetting, environmental controls, locking systems, siren or other audible signals, fuel flow, fire detection and the like.

BSPR:
The system also permits full situational awareness capability where all ground or water transports in the are provided with GPS location information such that the ground crew will know where all assets are at any point in time. This can provide both collision avoidance as described and also check to assure that the transports are in an authorized area. A composite of all transport location information can be used to provide a "live" display of all assets in the area. Logging of this information will provide good archival information in the event a reconstruction of events, such as a security breach or collision, is required.

BSPR:
The comprehensive multi-media system of the subject invention permits the collection and dissemination of virtually all data associated with the commercial transport at any time, both while in port or in service. In the preferred embodiment a combination of sensors systems are used, with sensors being installed within the transport, on its exterior and at ground-based locations for

monitoring the transport when is in port. In such areas where ground based systems are not available, the transport-installed systems still provide useful and enhanced information over the prior art. Likewise, in those areas where unequipped transports enter a system equipped port; the ground based system of the subject invention can communicate via standard ground-to-air radio to provide useful information such as perimeter surveillance and the like. For example, even without the use of on-board systems, the identification number (such as the tail number on an aircraft), owner, state or country of origin and other identifying information can be matched with available data to provide immediate and accurate identification of a specific commercial transport. This permits efficient tracking and response capability of the transport in port, on the ground, or anywhere in the world using satellite communications.

BSPR:
In the preferred embodiment, fixed view and steerable video cameras may be incorporated either on the commercial transport or independently of the transport at ground based sites where commercial transport is located in order to monitor movements around the perimeter of the monitored commercial transport. It is also desirable to include focusing and/or timing functions so that selective pan, tilt and/or zoom (x,y,z) positioning can be utilized. The cameras may be activated and/or aimed and/or focused based on the location data provided by a GPS system integral to the monitored commercial transport, may automatically pan an area, or may be manually operated by crew or ground personnel. Automatic tracking of each transport in the terminal by one or more tracking cameras in conjunction with a recording device can provide an archival record of each asset in case of a detrimental event, such as fire, terrorist event, theft, collision and the like.

BSPR:
Several video cameras may be placed such that the lens of each is aimed through a window opening provided in the fuselage or body in order to provide video imaging of the engines, tail section, and/or landing gear and other functional components of an aircraft. Cameras may be placed throughout the interior of the commercial transport on the flight deck, in the cargo hold, in passenger cabin and/or other desired spaces including on the ground outside the commercial transport. The audio sensors/transducers and/or other sensors and detectors are also strategically located throughout the commercial transport and positioned at strategic locations both internal and external of the fuselage. External sensors based on the ground area surrounding the commercial transport may also be added.

BSPR:
In the one embodiment. information from the plurality of sensors on the transport is synchronized through an on board capture/multiplexing system whereby the plurality of data, including visual image data, may be displayed, recorded, and/or transmitted in either a split screen or serial fashion. A "time-stamp" or chronology signal may also be incorporated in the data scheme. Any signal which is capable of being captured and stored may be monitored in this manner. Utilizing the wireless system of the invention in combination with the battery back-up power supply, it is possible to continue collecting information without using ground power or commercial transport power. This assures that the system will operate even if power is disrupted for any reason such as, by way of example, tampering by unauthorized personnel or by fire. In its simplest form, only triggered (activated) sensors are active, i.e., an activity at the site causes a triggering effect and activates the sensor, and only the signals generated thereby are transmitted to the security station. In such a system, multiplexing of continuous signals is not nearly as critical. The "time-stamp" is particularly useful as an aid in reconstructing the events in a "postevent" investigation.

BSPR:
The LAN transceiver is the interface into the LAN. The LAN transceiver can accept software downloads from various system elements to enable the multi-media sensor system to be maintained or upgraded to perform other functions. Other sensors may also be incorporated in the system, such as motion sensors, smoke and/or fire sensors and the like. The system is configured for selectively transmitting all of the data on a "real-time" or "near real-time" basis, i.e., the data is delivered with only delays for processing time such as compression/decompression, multiplexing and the like. The system is also adapted to provide the monitors access to serial, synchronized full screen view of each of the cameras, in sequential viewing, or alternatively to provide split screen or multi-monitor

viewing of a plurality of cameras. The system may be hardwired or wireless transmission may be utilized to further minimize the possibility of a malfunction at the onset of a catastrophic occurrence and to make the system more tamper resistant.

BSPR:
The comprehensive surveillance/communication of the subject invention supports communication of monitored data and/or commands or operational data between the ground or base station and the transport. between the transport and ground or terminal support vehicles and/or equipment, between the transport and various monitoring stations or systems, between transports, between the ground station and the support vehicles, between the monitoring station and support vehicles and between the monitoring stations or systems and the support vehicles. This permits the ground station to monitor and/or determine the identity, location, and heading of any vehicle in its range for tracking and collision avoidance, as well as monitoring sensor information, alarm conditions, emergency conditions, servicing requests, maintenance information, navigational information, requests for information such as flight plans, weather information, route maps, message traffic such as e-mail and the like. Similar information may be transmitted and received between transports, between transports and support vehicles and any of these and the ground station. The ground station may also send operational commands to the various monitoring systems both on-board the transport and ground mounted, such as camera tilt, pan and zoom and sensor activation. Other command signals such as "lock-on" a specific condition or transport, sensor download, activation such as "lights-on" or alarm (e.g., siren) activation and the like.

BSPR:
In a typical application. when an alarm from a specific transport is sent to the ground station it will be tagged with the GPS coordinates of the transport. The alarm will also be reported to a security system, typically including a computerized center that distributes the information of the wireless LAN and. where used, the wired LAN. The mobile and/or personal security units will also report their GPS coordinates to the central computer so that the system knows the location of all security personnel at ant point in time. Once the alarm signal is received, the system can search and identify the closest appropriate personnel and alert them of the alarm condition. This is accomplished by calculating the length of the vectors between the transport GPS and the various personnel GPS signals. The shortest vectors are the nearest personnel and these can be alerted to respond to the alarm condition.

BSPR:
It is a primary object of the subject invention to provide the means and apparatus for a comprehensive, multi-media traffic management, surveillance and monitoring system for monitoring and tracking a commercial transport vehicle while in port or while in route.

DRPR:
FIG. 7 is an illustration of an aircraft as an exemplary commercial transport and shows the incorporation of on board systems with the comprehensive tracking and monitoring system of the subject invention.

DRPR:
FIGS. 9 is an expansion of the system shown in FIG. 1, utilizing a remote receiver and monitor station in combination with hardwired ground components, wireless ground components and an aircraft system interface.

DEPR:
It will be readily understood that the various components and features of the subject invention can be utilized in connection with a tracking, security and/or surveillance system for any of a variety of commercial transports. For purposes of brevity, the features of the invention are described in detail herein as applied to commercial aircraft. This is primarily because it is assumed that aircraft systems are likely to incorporate the most complex and comprehensive surveillance systems of the subject invention due to the importance of securing this commercial transport while on the ground and both the importance and complexity of monitoring and tracking same while in port or in route. The system may be scaled up or scaled down depending upon application. For example, land vehicles such as railroad rolling stock or over the road trucks may need only door sensors, motion sensors and brake monitors, whereas aircraft, as described,

will require a substantially more comprehensive system in order to provide adequate surveillance. In the preferred embodiment for aircraft as described in detail herein, the comprehensive surveillance system utilizes the onboard aircraft system in combination with a ground-based wireless system. The wireless configuration can also be applied to the sensors on board the aircraft using the same architecture as described here for the ground based portion of the system. That is, the on board elements may be hardwired, may communicate through wireless radio, or may utilize wireless LAN as herein described, or a combination. The LAN radio provides a wireless LAN connection to other system elements. This is a well-know but evolving technology that allows high bandwidth wireless data transmission between multiple devices. Several different techniques are available from a variety of manufacturers, including Raytheon Systems Corporation, the assignee of the subject invention. Many of these techniques may be utilized in the subject invention.

DEPR:
The comprehensive system includes various condition sensors, motion and audio detectors, video cameras, light detectors, sound detectors, contact switches, temperature detectors and control systems for controlling light, and sound transmissions to the aircraft. A temperature and/or humidity detector may be used for general monitoring functions such as predicting the icing of the wings in winter conditions, or for fire alarm functions. The temperature detector may be any known form for temperature transducer, such as a PTC, NTC, thermistor, or semiconductor element. More advanced semiconductor elements may be used, such as integrated circuit types that may include integral temperature and/or humidity sensors, references, analog/digital convertors, protocol engines and serial driver. Further, integrated circuits can incorporate on-board digital radio elements such as DSP based radios to be completely integrated self-contained chips. The temperature analog/digital convertor adapts the ambient temperature of the environment into a digital data stream. This digitizer runs at suitable rates for continuous temperature monitoring. A signal processor can be used to provide correction to the temperature and/or humidity elements, such as processing out non-linear characteristics of the sensors. It can also be used to look for profiles such as rapidly rising temperature/humidity conditions that may indicate a fire or open door or other security breach. Detection of such an event would trigger a specified unique alarm condition to be transmitted back to other elements of the system.

DEPR:
One of the most significant factors in determining the overall complexity of the system is the cost associated with the various sensor components. For example, in certain applications it may be desirable to add a humidity detector or a carbon monoxide detector. A digital camera may be used, or an analog camera may be used in combination with an analog to digital convertor, or digital with internal digitization circuits, or digital compressed with an internal analog to digital convertor and a motion video compressor. In the preferred embodiment, the camera runs at full-motion rates. However, it will be readily understood that the camera can run at lesser rates for still frame or step video applications. In all cases, accurate information can be supplied on a "real-time" basis, i.e., the information can be transmitted, received and acted upon by man or machine in a timely fashion, sometimes with slight delays, to permit adequate response to an event. The video analog/digital convertor is functional to adapt the analog light modulated signal representing the video scene into a digital data stream. This digitizer can run at "real-time" rates for processing full motion video, or could operate at lesser rates for still frame or step video applications. The signal processor/motion video compressor is flexible and will provide various functions depending upon application. For example, the video processor/compressor subsystem can be programmed to perform functions such as motion detection in several well-known manners and methods. Several techniques are utilized to accomplish motion detection, but the most general method involves capturing repeated video frames and comparing differences in those repeated frames over time. Other techniques such as edge analysis, which looks for specific characteristics in the image, and the changes in such characteristics, may also be used. The processor/compressor subsystem can also be used to image process the video for purposes of contrast enhancement, dynamic range improvement, noise reduction and/or other well-known video processing methods, or other circuitry so configured to perform the processing by well-known techniques. When the video processor/compressor is used for motion detection, any detection will generate a specified unique "alarm condition" to be transmitted to other elements of the

system.

DEPR:
FIG. 1 is an illustration of a basic ground based security and surveillance system for aircraft. The aircraft 10, 10a, 10b. . . 10n will be within the view of video sensors or cameras 210, 210a . . . n when on the airport ramp. The video processor/compressor can also be used to perform still image compression to reduce the amount of data required to be transmitted over the network. This can be accomplished by using any suitable image compression algorithm, such as the industry standard JPEG algorithm, wavelet compression, DjVu from AT&T, or other techniques. For full motion video surveillance applications, the compressor 406 may be used to provide bandwidth reduction motion video transmissions. In this application, the amount of data representing a full motion video stream would be reduced by using full motion video compression techniques such as Motion JPEG compression, MPEG compression, motion wavelet compression, or other techniques. This allows better bandwidth utilization of the wireless and wired communications channel used by the system.

DEPR:
The aircraft will transmit various identification signals, such as tail number, GPS location and the like, as indicated at 12, 12a . . . n, to a ground based receiver 14. The camera 210, 210a . . . n will also transmit video signals to the receiver 14, as indicated at 15, 15a . . . n. The location of the cameras will be fixed, but may be either permanent locations or "drop and place" movable units dispatched as needed, based on changing security situations. It is also possible that portable cameras will be transported by the aircraft then deployed on the ground, permitting ground surveillance in those airports where a permanent ground security system is not installed. The GPS coordinates of ground based cameras will be stored at the ground or base security station 18, or as preferred in the case of drop and place units, will be sensed by on-board GPS receivers and transmitted to the base station. The received videos from cameras may be converted by optional convertor 16 as required and transmitted to the monitor of the ground based security station 18. The convertor is used to provide compatibility between the transport's format and the ground system format. For example, for analog transmission an aircraft may transmit analog NTSC video in the United States and PAL in England. Digital transmission may be accomplished by placing the convertors at each camera transmitting unit (see FIG. 3) thereby supporting digital data transmission for permitting transmission by the preferred wireless digital system, such as a LAN or W-LAN.

DEPR:
By monitoring the identification information from each aircraft, the transmitted video format from the various cameras can be matched to a specific aircraft. The signal is displayed on a monitor at station 18 where it can be viewed and monitored for surveillance and security purposes. In the event of a breach of security, security personnel may be readily dispatched to the correct aircraft using the GPS location signal to define an accurate position of the aircraft. As will be described, the security signals generated by the system of the subject invention may also be logged and inventoried for later play back, which is particularly useful for reconstruction of events. It will be readily understood that the ground components of the system may be hardwired, or other forms of wireless communication, such as, by way of example, a wireless local area network (LAN) could be utilized using radio frequency or optical communications methods, as will be readily understood by those who are skilled in the art. The system can also be modified to transmit signals from the ground-based station 18 to the various ground sensors and aircraft sensor systems. For example, a camera 210 can receive and respond to remote positioning and zooming signals. Audio warning and activation signals may be sent to the camera locations and to the aircraft to activate audio commands, sirens, lights and the like, which are integral to the system.

DEPR:
FIGS. 2a and 2b show two different schemes permitting transmission of monitor system data from a transport 10 to a base station monitor 18 using a wireless transmission scheme as indicated at 12. In FIG. 2a, the camera or sensor (for example camera 29) produces a signal which is transmitted as generated by the aircraft transmitter 76 to the base system receiver 14 and then converted at the base system by format convertor 400 for processing or viewing at the base station in its native format. Where desired, the convertor may be at the sensor site as

indicated in FIG. 2b. Of course, depending on the various systems being utilized, multiple conversion steps may be utilized. Format conversion capability is required in order to make the system global in nature. For example, the format of each aircraft is often dependent on the country of origin. The United States and Japan generally use an NTSC camera format. France and Russia use SECAM. The United Kingdom typically uses PAL. It is important that the ground or base station be able to recognize and convert any of these formats to a suitable format for processing by the base. Compatibility with multiple, yet different, systems can be automatically accomplished. Instant protocol detection and conversion is shown and described in my copending application, Ser. No. 08/816,399, filed on Mar. 14, 1997, entitled: "Instant Protocol Selection Scheme for Electronic Data Transmission via a Distributive Network".

DEPR:
As shown in FIG. 5, the camera system includes a base or mounting bracket 56 for mounting the system at location. The system body 52 is mounted on a tilt mount 54 (y-axis) and pan mount 50 (x-axis), permitting panning (x direction) and tilting (y direction) of the camera for scanning a wide area. A motorized zoom lens 58 is provided (z direction). The preferred embodiment of the system also includes an audio sensor such as directional microphone 60. The audio sensor may be an acoustic transducer, such as a microphone, that collects audio information from the surrounding area. The collected audio can be processed to detect potential emergency conditions such as a gunshot or an explosion, or can be routed directly back to the monitoring station. Using the sensors of the subject invention, locational origin of an explosion or a gunshot or the like can be triangulated from multiple sensors and the positional origin can be calculated and displayed on maps as an overlay for assisting in pursuit of a perpetrator. The calculated origin can also be correlated by computer to the nearest appropriate emergency assets, base upon their known positions, and those assets may be automatically dispatched. The audio analog/digital convertor adapts the acoustic signal representing the audio environment into a digital data stream. The digitizer runs at real-time rates for real-time audio monitoring. The audio signal processor/compressor has two functions. It is programmed to perform detection in a number of different manners. For example, the processor algorithms can be adjusted to detect impulse noises such as gunshot or a small explosion. Detection of such an event would trigger a specified unique "alarm" for that condition to be transmitted back to other elements of the system. Other types of detection are also possible. By using frequency analysis transforms and signature profiles, noises from engines, door openings or other distinctive noises could be detected when warranted by the situation or condition. For audio surveillance applications, the compressor can also be used to provide bandwidth reduction for audio transmission. In this application, the amount of data representing a real-time audio stream would be reduced by using audio compression techniques such as LPC-10, or other well-known or proprietary algorithms. This allows better bandwidth utilization of the wireless and wired communications channels used by the system.

DEPR:
An integrated GPS receiver 64 is provided for generating location information. This is particularly useful for "drop-and-place" sensors as opposed to permanent sensors. Other features such as a laser range finder 66 that can measure distance to objects/personnel may be incorporated to further expand and enhance the capability of each sensor component. The camera system shown has full 360 degree field of view capability which may be controlled manually by remote control signals, may be programmed to pan the area on a time sequence, may track a moving transport using GPS signals from the transport or by using image processing "tracking software" processing the camera image, or may be responsive to and activated by an event occurrence such as from sensors distributed throughout the ramp areas, reporting activity over the LAN, in the well known manner. The range finder 66 permits the tracking system to locate objects in a precise manner and then provide control signals to permit accurate surveillance and monitoring of same, such as zooming the camera or positioning of other sensor elements. An onboard dual GPS systems on the aircraft, with one GPS at the tail and one at the nose, used in conjunction with the GPS system 64 permits the system to determine size, heading and distance to the aircraft being monitored, providing accurate location information and permitting the camera to automatically adjust to monitor the entire aircraft within its range. This permits the selection of the correct camera when multiple cameras are available and permits a wide range of viewing possibilities by being able to determine what portion, if not all, of the

aircraft is to be monitored at any given time. In those instances where the aircraft is equipped with a single GPS system, much of this versatility is preserved. However, it will be understood that aircraft size then would have to be determined from the aircraft type or by optical means. When the transport is not equipped with the GPS system, the other sensors such as the range finder/tracking camera or ground level sensors would provide data for cameral selection and updating of electronic situational maps. Each sensor and/or camera may incorporate a motion sensor and/or an audio sensor activation device so that the system may be activated when a sound or a motion occurs within the sensor range. The motion detector may comprise any transducer unit that can detect the presence of an intruder and can be a device such as an infrared motion detector, a thermal sensor, an ultrasonic detector, a microwave detector, or any hybrid of two or more of these detectors "fused" together to gain better sensitivity and/or improved detection accuracy. A motion detector convertor may be incorporated to convert the signal from either a single motion detector sensor or a battery of sensors to digital form for processing and/or transmission to other system elements. Multiple elements may be contained within a single sensor system package, or may be fused for multiple sensors in geographically distributed elements with data to be fused being transmitted over the LAN. The motion detector signal processor is adapted for analyzing the sensor data streams from one or more sensors to provide for better sensitivity or improved detection accuracy. Well-known techniques may be implemented to process the transducer data and detect surges over the set thresholds that represent detection. The processor/compressor can also be configured to accept input from multiple sensors and process the inputs in a "fused" manner. For example, signals form an infrared detector and ultrasonic detector may be "added" together, then threshold detection performed. This ensures that both an optical and an acoustic return are detected before an alarm condition is broadcast. These and other more sophisticated well known techniques can be used together to gain better sensitivity and/or improved detection accuracy. Detection of such an even would trigger a specified, unique alarm condition to be transmitted back to the other elements of the system.

DEPR:
Typically, the sensors will "sense" the presence of unauthorized activity and activate recording from the various audio and/or video equipment and activate alarms. This will initiate the generation of a signal at each of the activated units. The generated signals will then be transmitted to the monitoring and recording equipment, as described, to permit both real-time surveillance and recordation of activity at the site. Motion detection may also be determined using video time/change techniques in the well-known manner.

DEPR:
FIG. 6 is an expansion and further refinement of the system of FIG. 1 and is a diagrammatic illustration of the system of the subject invention as configured for a wireless local area network (LAN). In the preferred embodiment the aircraft 10 will include a comprehensive in-flight security system, as better shown in FIG. 7, which is cutaway diagram of atypical commercial airline fuselage 10, with the cargo hold 12, the passenger cabins 15, 16 and the flight deck or cockpit 21 partially visible and a plurality of sensors 19a-n. A more detailed description of this onboard system is shown and described in my aforementioned U.S. Pat. No. 5,798,458 and copending applications Ser. Nos.: 08/729,139, and 08/745,536. In the subject invention, the currently available sensors may be utilized, without additional enhancements or a number of additional sensors may be added. For example, ground surveillance could be accomplished using only the on-board sensors on the aircraft. In the example, a number of video image sensor devices such as, by way of example, analog video cameras, may be mounted inside the skin of the aircraft and aimed through openings or windows provided in the fuselage to focus on critical components of the aircraft, such as the landing gear cameras 20, 22, the wing engine camera 24 and the tail camera 26. Similar devices or cameras may also be strategically placed throughout the interior of the aircraft, such as the passenger cabin cameras 28, 30, 32, 34, 36, 38, 40, the cargo bay cameras 42, 44, 50 and 52, and the flight deck camera 46. The sensors 19a-n may include smoke and fire detectors, motion detectors and audio sensors strategically placed throughout the aircraft, both internal and external of the fuselage. The placement and number of devices is a matter of choice depending upon the configuration of the aircraft and the level of surveillance desired. In the preferred embodiment the on-board aircraft sensor system is used in combination with the ground based system to provide a comprehensive surveillance

and security system of the aircraft while on the ground.

DEPR:
With specific reference to FIG. 6, in the preferred embodiment the aircraft 10 will also include a nose GPS sensor 200 and a tail GPS sensor 202. The dual GPS sensors permit redundancy, very accurate location and directional positioning of the grounded aircraft, as well as providing information identifying the size of aircraft. An aircraft reference signal (such as tail number) country of origin, owner, and the like, may be incorporated in the transmitted signal so that the monitoring station can identify the aircraft, its location and the security condition thereof by monitoring the signal from that specific aircraft. In the wireless embodiment shown, the aircraft is equipped with a wireless transceiver 204 for transmitting all of the collected signals from the sensors and cameras via the wireless network represented by the wireless communication "cloud" 206. The wireless system shown in FIG. 6 permits transmission not only to the ground control tower and security, but expands the transmission of data to all locations and stations which are part of the wireless system. For example, the signals may be transmitted to a patrolling ground security vehicle 208, a portable monitoring station 218 and/or to the ground security center via the wireless LAN transceiver 212. In addition, signals may be transmitted in either a send or receive mode from any unit in the wireless system to any other unit therein. This is particularly useful when trying to coordinate a response to an incident in a quick response mode.

DEPR:
The wireless LAN 206 or other wireless communication system provides a connection between the aircraft 10, the fixed ground resources via transceiver 212, mobile ground resources such as the security vehicle 208, portable ground resources such as the portable ground security station 218 and various functional or operation centers such as the control tower 216, the operations control center 220, the security center 222, the maintenance center 224, the maintenance hangar 214 and the airport fire station 226.

DEPR:
In the preferred embodiment, and as shown in FIG.6, the portable (or drop in place) camera/sensor/link device 210 (see FIG. 5 and accompanying description) is adapted for providing any combination of video surveillance, audio surveillance, motion detection, acoustic detection, sensor positioning capability and wireless link to other system elements. The security vehicle 208 is equipped with a sensor viewing capability as well as an alarm annunciator to alert the operation for quick response. Typically, the transmission of an alarm signal by the aircraft will trigger a link-up at the various monitoring units and will interrupt routinely monitored signals. The alarm signal will include aircraft identification and location data, as well as an indicator of the sensor triggering the initiation of the alarm signal. The alarm location may also be displayed on a "moving map" display, in the well know manner. This permits a quick response team to focus on the incident causing the generation of the alarm signal. In the preferred embodiment of the invention, the alarm at the sensor location is adapted to operate in either an audible or silent mode, depending on the surveillance operation. For example, a warning signal may be broadcast at the location to scare off intruders who breach a restricted area or, in the alternative, the warning signal may only be transmitted and sounded at the base station and/or security vehicles alerting base personnel of a situational change at the monitored zone. Hand held or belt mounted wireless LAN personal security assistants can also be used. These would allow personnel to have access to critical security information while on foot patrol or making rounds, permitting almost immediate response to activating conditions in their vicinity. This would also allow the automatic signaling and dispatch of personnel based upon their identity or based upon their GPS determined location.

DEPR:
The system wireless LAN transceiver 212 operates as the gateway to the ground based, permanent, wired facilities. A router 228 is provided to bridge the various airport facilities (i.e. an intranet). The router is a typical industry type, as is well known to those skilled in the art, and may be installed in many configurations as required. Where desired, the system may be connected to remote nodes as well, through a wide area network (WAN), permitting connection to FAA regional centers, airline corporate operations or aircraft manufacturer operations, for example. The router may be configured as needed with typical

commercial techniques, such as firewalls to protect access, protocol convertors, and encryption devices, as needed to direct secure or unsecured information to the various ports, nodes and centers.

DEPR:
Where desired, only preselected alarm signals may be transmitted to selected centers. For example, any heat or smoke detection, fuel spill detection or medical emergency would generate an alarm signal at the fire control center 226. The maintenance hangar may have access to fluid sensor data and stored maintenance requests and records. Thus the system can be configured in an information hierarchy format where only useful information is forwarded to the various centers.

DEPR:
The use of the dual GPS receivers 200, 202 on the aircraft 10 permits the reporting of the general location of the aircraft on the ramp during taxi when parked whether or not attended. The use of two GPS receivers provides redundancy, better accuracy and orientation information for the aircraft by reporting two distinct position datum signals. It will be readily understood by those skilled in the art that other position signal devices could be utilized such as, by way of example, a single GPS receiver and a magnetic compass (which may have to be corrected for local magnetic fields or interference). By linking the position and orientation information to the ground based centers the location and orientation of the aircraft at all times it is on the ground the aircraft may be closely monitored. Such a system provides ground control transmitting signals showing the location and movement of all aircraft while on the ground, in much the same manner the radar transponders provide air controllers with position and movement data while the aircraft is airborne. This is particularly desirable when the movement of aircraft is portrayed on a map display. Other ground vehicles such as fuel trucks, waste water trucks, baggage handling trains, security vehicles and the like can also be tagged with GPS receivers and LAN transceivers for monitoring their position relative to the aircraft on the ramp. An automated computer system can be operating in the background looking for potential collisions and generating alarm messages if such a conditions is detected. Another automated computer function can track vehicles relating to their authorized areas and issue alarms if security is breached. Yet another function can track the presence or absence of needed services, such as the timely appearance of catering trucks, fuel trucks, wastewater trucks, baggage trains and the like after the arrival of a subject transport. If any of these required services do not arrive at the transport within a prescribed time period, and "alarm" can be reported over the LAN to the missing services vehicle, and/or to the responsible operations center. This function can be completely automated by a controlling computer system.

DEPR:
As shown in FIG. 8, in a typical installation, external sensors 210a-g placed on the ramp in the vicinity of the aircraft to monitor the exterior of the aircraft. For example, a plurality of video cameras 210a and 210b may be placed along the exterior fence 300 of an airport. In additions, cameras may be placed in other strategic locations such as the camera 210c mounted on the terminal building 310 and the remote cameras 210d-n mounted on base units 312 located strategically throughout the airport. When an aircraft 10 is parked on a surveyed area of the airport ramp 314, the various cameras 210a-n and or other ground based sensors will provide a secure area for the aircraft. Any activity within the range of the cameras may be viewed and monitored.

DEPR:
The system of the subject invention is designed such that aircraft onboard sensors and ground-based sensors may be used in combination to provide a comprehensive security system. The ground-based sensors may be used alone to provide basic ground security. The aircraft sensors may be used alone to provide some ground based security with a minimum of modification to existing hardware.

DEPR:
In the embodiments shown and described, a multi-media recorder is utilized to record the information for archival purposes. This can be a ground based recorder or the aircraft "black box" recorder 58 (shown as installed in the tail section of the aircraft, see FIG. 7) may be utilized, in the same manner as the current data and voice black boxes (not shown).

DEPR:
Audio and video monitors are also provided at the base security station to provide near real-time surveillance. The flight deck monitor and control panel 54 is located on the control panel in the cockpit 21 will also have access to this information. Other monitors may be provided where desired.

DEPR:
Turning now to FIG. 9, the system shown is adapted for wireless installation using both onboard aircraft sensors and ground based remote sensors. The system shown relies on the standard on-board radio of aircraft 10 to transfer all aircraft signals to the base station receiver 81 via antenna 81a. In the alternative embodiment of FIG. 9, the ground-based cameras (camera 210d) and a motion sensor 31 are hardwired as shown at 87 to a controller 85. The on-board signals are input from the receiver via hard wire 89. Wireless ground based sensors such as the camera 210a and the motion detector 31a may be used in combination with the hardwired ground based cameras (see camera 210d) or other hardwired sensors. This permits maximum flexibility of the system architecture. The wireless signals will be transmitted via a dedicated sensor array transmitter/receiver 83 and antenna 83a.

DEPR:
As shown in FIG. 10, the use of a wireless network provides maximum versatility in the transmission of information and the monitoring and processing capability provided by the system. As indicated in FIG. 10, the transport 10 both sends and receives information between the ground station 18, as previously described and as indicated by the wireless data path A. The transport may also transmit and receive between the fixed sensor station(s) 20 as indicated by wireless data path C. The fixed sensor station is also in direct communication with the ground station as indicated by wireless data path D. It should be understood that permanent installations such as the ground station and the fixed sensor station could be hardwired with one another without departing from the scope and spirit of the invention. In addition, support vehicles such as, by way of example, the baggage train 13 may be equipped with sensors such as location sensors and the data generated by this sensor may be transmitted to the ground station via path B, the monitor station via path E and directly to the transport via path F. The ground station 18, monitor station 20 and transport 10 may also communicate directly with the ground support vehicle 13. For example, if the ground support vehicle comes within a designated "keep-out" or no trespassing zone or is too close to the transport, a proximity sensor or calculated from the GPS data may be utilized to activate and send a warning signal to the ground support vehicle. As indicated by wireless path G, sensor data may also be communicated between multiple transports 10 and 10a.

DEPR:
The comprehensive system of the subject invention not only provides surveillance of the aircraft while at the gate or while unattended, but also provides taxi protection and monitoring. As shown in FIG. 11, when all ground vehicles such as fuel truck 11 and baggage train 13 are outfitted with GPS receivers as well as the aircraft 10, the location and safe distance of each vehicle and the aircraft may be monitored. "Train" type vehicles may be outfitted with two or more GPS receivers to relay the length of the vehicle. Each car can have a separate module. A computerized map of the airport tarmac T, the taxiways P and runway R can be generated showing the position, direction and movement of each vehicle and the aircraft. Predefined keep-out "zones "Z" may be established and an alarm may be sounded if the zones are breached. Also, prescribed areas for authorized vehicles may be established and monitored. If a vehicle is outside the designated area, or breaches a zone "Z", an alarm condition will result. This can be prioritized as a cautionary breach, a dangerous breach and so on, depending on proximity of the various vehicles and aircraft to one another. For example, if an aircraft 10 comes too close to a fuel truck 11, alarms in the aircraft, the fuel truck will be activated. In the situation advances to a danger zone, a second alarm condition may alert ground or base personnel that a breach has occurred so the intervention may be initialized. Logging of the "safety" breaches can be made so that safety improvements or training may be implemented based on need.

DEPR:
A combination of ground sensors in a matrix on the airport ramp (see sensors 210a-210n in FIG. 8) will scan and monitor vehicles. If a vehicle is detected

that does not have a GPS identification authorized for that location and alarm condition will result. For example, if a stray baggage train 13 entered the taxiway area, an alarm would sound indicating that the train 13 has entered an unauthorized area. Emergency and security personnel may also be alerted and dispatched if unauthorized or untagged (no GPS identifier) vehicles are present. This protection scheme could be expanded to include personnel as well as vehicles. For example, the ground vehicle can have a sensor that reads a personnel security token or device such as an encoded digital key. This key information would enable the vehicle and would also be encoded with GPS information and vehicle identification, which is transmitted over the LAN. Security software can then check to determine if the individual is authorized to be present in the vehicle at that time and location, activating an alarm if proper authorization is not confirmed. The vehicle could also be immediately shut down. Visual identification of personnel may also be accomplished using the sensor systems of the subject invention.

DEPR:
As shown, a variety of image sensor devices may be incorporated, including the video cameras C1, C2, C3 . . . Cn, an advanced imaging device such as the FLIR camera 220, the on board radar 222 and the like. All of these produce a visual signal. In addition, various audio signals may be incorporated utilizing a variety of audio sensor devices, such as a cockpit voice sensor 113, on board radios 224, 226 and the aircraft public address system 228. All of these produce an audio signal. The operational data signals are also incorporated, as previously described, and may include the GPS sensor 72, other navigational sensors 230, the various intrusion sensors 115 and other sensors 125. Thus, the system of the subject invention will accommodate a multiple input, multi-media array incorporating video, audio and digital data signals into a comprehensive database for providing detailed information relating to the aircraft condition at any time.

DEPR:
The visual and textual data is available at a display monitor 54. The audio signal is output at 237 to an audio output system such as amplified speaker 240. All of the data, including all video, audio and digital data will be recorded on the recorder system 70. Information representing audio, video, sensor data, and other vital digital data is fed from the multimedia multiplexer to the recorder 70 over the signal lines 233. It should be noted that the multimedia multiplexer may be analog, digital, or packetized digital data type, or a combination of technologies based on application. Where desired, selected portions of the systems data on the aircraft may be downlinked to the ground or base station 18 (see FIG. 2) as the combined, comprehensive output signal on line 246 to be transmitted to the ground station via the aircraft radio system 80 and the antenna 82. As previously described, the information may also be transmitted to a wireless satellite via transceiver 280 and dedicated antenna 282. Once the information is generated as a useable data signal, as indicated at line 231, 233 and 235, the controller, in combination with commands from ground security, controls the collection, monitoring and review of the information. This permits access to any single sensor signal, or any combination via line 231 by sending a command via line 248 to the controller 241 for controlling the monitor related multiplexing switches via line 243 to control the signal output on line 231. For example, this may be a single camera view or an array of intrusive motion sensors 115.

DEPR:
Where desired, a light level detector may be is used for detecting light conditions such as the ambient lighting or transient conditions such as vehicle headlights or a flashlight. The light detector analog/digital convertor adapts the ambient light levels into a digital data stream. this digitizer runs at rear-time rates for teal-time illumination monitoring. The light detector signal processor can be programmed to look for profiles such as rapidly increasing light conditions that may indicate a vehicle or a flashlight as opposed to the rising or setting sun. Detection of such and event would trigger a specified unique alarm condition to be transmitted back to other elements of the system.

DEPR:
FIG. 15 is a diagrammatic illustration of the placement of tracking sensors on the ramp and taxiways of an airport for tracking the movement of the commercial transports such as transports 10a and 10b as they come into the gate area 350.

The sensors S1-S32, are strategically place to track the transport as it proceeds along the runway, the taxiway and the ramp. This is particularly useful for aircraft which do not have GPS signal generating sensors, making it possible to track and identify the transport at any time. Various sensing devices can be utilized in this configuration such as acoustic sensors, acoustic return "sonar", optical, optical return, microwave, microwave return, contact or weight detection, electronic proximity (underground wire), or similar sensors. The sensor system detects the transport, and where return sensors are used, will also identify the distance. By using sequential sensors, the speed and direction of travel may also be calculated. This type of sensor system will also detect the presence of other assets or personnel in the area.

DEPR:
FIG. 16 is an expanded illustration demonstrating the calculation and signaling of appropriate personnel and equipment to the site of an event requiring emergency response. By way of example, assume the tracking camera 210a and 210b provided a visual signal indicating smoke at transport 10. At the same time, the on-board fire and smoke detectors would transmit a signal to the ground based transceiver 212 via the wireless LAN. In addition, the precise location of the transport will be known because of the location signal generated by the transport GPS sensor 200 which is also transmitted over the LAN. The receipt of these various signal will activate several actions. First, all of this information will be transmitted to the ground control tower 216 and to the operations control center 220, as has been previously described herein. The airport fire station 226 will be alerted to the indication of a fire and smoke event and the security center 222 and maintenance center 224 will receive appropriate information. The automated dispatch computer center 225 will monitor the location signal provided by the transport, as well as the location signal of on ground personnel 218a-218c, response vehicles 208a-208c and fire support vehicles 352a-c. By monitoring the type of event that has occurred and both the type and location of available personnel and equipment, the dispatch center can alert and initiate the most efficient appropriate response. The location signals provide sufficient information for the computer system 225 to determine by well-known methods, which asset is closest. For example, ground personnel 218b is closest and would receive the first response signal. If a response vehicle was programmed to respond, vehicle 208a would be first alerted. Likewise, the closest fire truck is truck 352c, which would be the first alerted. As back-up is needed, each of the ground support assets have the capability of signaling for additional support directly back to the dispatch computer. The computer can then select the next closest appropriate asset. The system of the present invention provides a comprehensive, efficient method of collecting, distributing and reacting to critical information to maximize the response of appropriate functional vehicles and personnel on a real time basis while assuring that assignments are prioritized as set by operational personnel. This greatly increases both the timing and the effectiveness of response to critical events.

DEPR:
The multi-media security and surveillance system of the subject invention provides an enhanced security scheme giving instantaneous and live image access to critical components and areas of an aircraft or vehicle, providing the ground based security personnel with additional information while the aircraft or vehicle is not in use and is left unattended. In addition, the permanent tape record will prove invaluable for investigating unauthorized activity or accidents after they have occurred. The preferred embodiment of the system is specifically designed for new commercial aircraft but is equally well suited for retrofit applications and for other safety applications as well, and may be scaled up or scaled down depending on application.

DEPR:
The video recorders, synchronizing networks and multiplexing and split screen hardware are well known and their adaptation will be readily apparent to those of ordinary skill in the art. Any suitable video recording format can be used, for example, an analog video tape recorder, a digitizer and tape, hard drive or optical drive configuration. Digital cameras could be incorporated in lieu of the standard analog type cameras currently in use in most applications. As digital technology becomes more readily available and more cost effective, it is contemplated that most of the imaging, monitoring and-recording equipment will be of a digital format because of the increased reliability and the minimized space requirements. Of course, it should also be understood that the monitoring,

transmitting and storage capabilities of the invention are also well suited for capturing any video or visual image generated by the on board avionics of the aircraft.

WEST

Generate Collection

L7: Entry 14 of 112 File: USPT Mar 27, 2001

DOCUMENT-IDENTIFIER: US 6208932 B1
TITLE: Navigation apparatus

BSPR:
Along with recent tendency to process computer-related data in multimedia, multimedia has also rapidly found its way to be utilized in automobiles. Types of information handled in automobiles are, for instance, navigation information, VICS (Vehicle Information Control System) information, audio/visual information, radio, information from on-vehicle telephone, information from teletext broadcasting, information received from vehicle systems and the like.

BSPR:
A most serious problem in processing information from multimedia is simultaneous occurrence of an enormous amount of data. More specifically, a driver in an automobile receives a large amount of information e.g. information from VICS, information from multiplexed audio broadcasting and the like, from places where the driver does not take any part in. The obvious characteristic of the multimedia in automobiles is in that, in a case where a driver receives image data by a multimedia system, if the driver is not interested in the image, the driver simply needs to look away from a screen showing that image, so that the driver is not disturbed while driving the automobile.

BSPR:
Particularly with respect to regulating audio information output, for instance, Japanese Patent Application Laid-Open No. 1-142994, No. 5-203458 and No. 5-332778 disclose controlling of mainly the volume at the time of outputting audio information. However, when volume is controlled, a driver is required to concentrate even harder on the contents of the information because low volume is difficult to hear.

BSPR:
Moreover, according to Japanese Patent Application Laid-Open No. 4-1898, the length of guidance provided as audio information is controlled in accordance with vehicle speed, to synchronize outputting of the guidance information with passage of neighborhood of a destination point, whereby making it possible for a driver to associate what is seen with the contents of the guidance.

BSPR:
In addition, according to Japanese Patent Application Laid-Open No. 5-118866, a degree of driver's familiarity with respect to each road is determined by accumulating the number of times of driving the road, and in accordance with the degree of familiarity, audio information offering is controlled to be turned on/off. Since a driver does not need to audibly receive information on a familiar road, such unnecessary audio information is not provided.

BSPR:
Even if the length of guidance provided as audio information is controlled in accordance with vehicle speed as disclosed in the aforementioned Japanese Patent Application Laid-Open No. 4-1898, in a case where a large amount of information occur simultaneously, a driver may receive information regarding the destination after the driver has already passed the destination.

BSPR:
In other words, all the above-described conventional techniques are not capable of handling a case where there are plural information occurred simultaneously to be provided to a driver. Since these conventional techniques did not expect the

arrival of the multimedia era in automobiles, drivers have to bear with useful and useless information mixed together.

BSPR:
Still further, in the navigation apparatus according to the aforementioned Japanese Patent Application Laid-Open No. 8-254437, either one of the two types of audio information (the aforementioned first type and second type of audio information) is always outputted whenever there is information to be provided. Thus, when both types of audio information occur, one of the types of audio information is outputted which may be useless to a driver at the time of output.

BSPR:
According to the navigation apparatus as the preferred embodiment of the present invention, the priority order is prescribed in accordance with a running state of a vehicle.

BSPR:
According to the navigation apparatus as the preferred embodiment of the present invention, the priority order is changed in accordance with change in the running state of a vehicle. Accordingly, the navigation apparatus can adequately provide necessary information without excessively providing information.

BSPR:
According to the navigation apparatus as the preferred embodiment of the present invention, the priority order is prescribed in accordance with running environment of a vehicle.

BSPR:
According to the navigation apparatus as the preferred embodiment of the present invention, the priority order is changed in accordance with change in running environment of a vehicle.

BSPR:
means for allocating, to inputted information, a rank indicating a type of the inputted information, and a priority order indicating a priority degree of the inputted information; and

DRPR:
FIG. 1 is an interior view of a vehicle showing the main part of a multimedia-type navigation system adopting the present invention;

DRPR:
FIG. 2 is a wiring view of a vehicle showing the way the navigation system shown in FIG. 1 is connected;

DRPR:
FIG. 6 is a table for managing attribute data (priority orders, rank, memory capacity and the like) allocated to each of the various data that are used in the navigation system of the present embodiment;

DRPR:
FIG. 11 is a table showing a setting table where urgent levels LVL of output timing is set, which is used in the navigation system according to the first embodiment;

DRPR:
FIG. 12 is a table for explaining the state of control operation in accordance with values of the urgent level LVL;

DRPR:
FIG. 21 is a table where variables "limitation LMT in number of times" are defined, which are used in controlling of the navigation system according to the first embodiment;

DRPR:
FIG. 22 is a flowchart showing a "obtaining number of times" routine in control steps of the navigation system according to the first embodiment;

DRPR:

FIG. 24 is an explanatory view showing operation of "obtaining number of times" routine in FIG. 22;

DRPR:
FIG. 33 is a timing chart explaining operation of the navigation system according to the second embodiment;

DRPR:
FIG. 34 is a timing chart explaining operation of the navigation system according to the second embodiment;

DRPR:
FIG. 46 is a flowchart showing a "obtaining number of times" routine in control steps of the navigation system according to the third embodiment;

DRPR:
FIG. 70 is a timing chart showing operation of the navigation system according to the ninth embodiment;

DRPR:
FIGS. 71A-71F are graphs for explaining the principle of calculating a time interval in the navigation system according to the ninth embodiment;

DEPR:
Preferred embodiments of the present invention will be described in detail in accordance with the accompanying drawings. As will be apparent from the following descriptions, the present invention is applicable not only to automobiles, but also to other movable bodies e.g. airplanes and ships.

DEPR:
FIG. 1 is a front view seen from a driver's seat in an automobile adopting the navigation apparatus of the present embodiment. FIGS. 2 and 3A show the system structure indicative of a state where the navigation apparatus of the present embodiment is installed in an automobile.

DEPR:
Referring to FIG. 2, reference numeral 2 denotes a centralized control unit which calculates various data (remaining fuel, mean fuel consumption, mean running speed and so on) related to running state of a vehicle and integrally controls each of the components described below. Reference numeral 3 denotes a LAN unit provided in the vehicle for controlling, e.g. an anti-lock brake system (ABS), sensors (not shown) necessary to control four-wheel drive operation and the like, and so-called local area network communication between a driving unit and the centralized control unit 2. Reference numeral 4 denotes a RAM card drive which is a device for reading/writing information from/to a RAM card which stores information related to a driver e.g. seat position, mirror position and the like. Reference numeral 5 denotes a data storage drive which is a device for reading/writing various data stored in a data storing medium such as an FD (floppy disk), MD (magneto optical disk), PD (phase-transition-type optical disk) and the like. Reference numeral 6 denotes an audio guidance speaker which outputs audio information from a navigation controller 17 via an audio output interface included in the centralized control unit 2. Reference numeral 7 denotes a microphone into which voice instruction of an operator is inputted and further transmitted to the navigation controller 17 via a voice recognition interface (not shown) included in the centralized control unit 2. Reference numeral 8 denotes a display such as a liquid crystal display and the like where a navigation screen, a screen for various input operation and conditions (running speed, air conditioning and the like) of the vehicle are displayed. In the front surface of the display 8, an input apparatus adopting a capacitance coupling method or method utilizing infrared rays is incorporated to enable input operation by touching the display panel. Reference numeral 9 denotes a portable telephone to which a telephone antenna 13 is connected. Reference numeral 10 denotes an operation switch which is used to perform input operation to the centralized control unit 2 and navigation controller 17. The reference numeral 17 denotes the navigation controller which searches for an appropriate route to reach a destination designated by an operator using the operation switch 10 on the basis of position information obtained by a GPS (Global Positioning System) antenna 11 and map information stored in a CD-ROM inserted in a CD-ROM changer 19. Based on the searched information, guidance is provided by displaying the

information on the display 8 or outputting audio information from the audio guidance speaker 6. The map information of CD-ROM read by the CD-ROM changer 19 is the basic data of route information which is displayed on the display 8.

DEPR:
As shown in FIG. 2, to the navigation controller 17, an FM tuner 16 which receives FM multiplex broadcasting compatible with VICS (Vehicle Information Communication System), and a beacon receiver 18 which receives a beacon signal from an electric wave beacon antenna 14 and an optical beacon antenna 15, are connected. VICS signals and/or beacon signals obtained by the above devices are interpreted as traffic control information and displayed on the display 8, then used as a condition (restricted condition) of route search at the time of route guidance. In addition, area information related to the area where the vehicle is running may be input from the data storage drive 5 to be used as display data. Since the technique of detecting the position of a vehicle by GPS is well known, description thereof will be omitted.

DEPR:
The navigation system described below restricts or prohibits to output information (particularly, audio information) which is not necessary by a driver or which is massive to be provided to the driver. When there are a plurality of audio information occurred simultaneously to be offered to the driver, it is necessary to select single audio information, i.e. specific information, from the plurality of audio information since only single audio information can be provided at once to a driver. According to the navigation system of the present embodiment, the single audio information is selected on the basis of "importance" of the information which is determined based upon an association between a priority order of the information itself and a running condition (running state, running environment, driving time zone, driving purpose and the like) which is independent from the information. Furthermore, when the foregoing conflicts occur, some data are deleted under a. predetermined condition. With respect to such data, a message indicating that the data will be deleted is displayed on a display; alternatively, the audio information subjected to deletion is, instead of being outputted audively, converted to text data and displayed on a head-up display shown in FIG. 1.

DEPR:
The display 8 in the present system includes a touch panel. FIG. 3B shows switches used for requesting a type of information by using the touch panel. As shown in FIG. 3B, a driver can access to the information in six different genre, e.g. "news," "weather," "sports," "traffic information," "vehicle information," "gasoline (GAS)" and the like. FIG. 3B shows the function buttons (switches on the touch panel) for accessing to these information. Upon pressing any of the switches, information corresponding to the pressed switch is provided to the driver.

DEPR:
The information genre switches (FIG. 3B) are also used to display genre necessary in the current running condition. For instance, "GAS" menu is displayed when the centralized control unit 2 receives vehicle information indicating that the amount of remaining gasoline is small. Such displaying is performed not because a driver has requested, but because the system has made a determination on the basis of various data. As another example with reference to FIG. 3B, "weather" menu is displayed when wipers start running because the system determines that rain has started.

DEPR:
The information subjected to be handled by the present navigation system shown in FIGS. 1-3A is provided by media such as, NAVI, VICS (Vehicle Information Control System), audio equipment, radio, on-vehicle telephone, teletext broadcasting, vehicle system and the like. As shown in FIG. 4, information handled in these media includes: vehicle information, NAVI information, VICS information, information from audio equipment, information from on-vehicle telephone, information from teletext broadcasting and so on. Specific examples of the information are shown in FIG. 4.

DEPR:
The navigation system according to the present embodiment utilizes aforementioned vehicle information, NAVI information, VICS information, information from audio

equipment, information from on-vehicle telephone, teletext broadcasting information and so on, as necessary information for navigating operation. However, in the multimedia navigation system, there may be a plurality of information to be provided simultaneously. When a large amount of information are provided simultaneously to a driver, the driver may feel uncomfortable, and in addition, providing too much information may confuse the driver. Particularly, in case of audio information, these problems are apparent.

DEPR:
Accordingly, the navigation system according to the present embodiments assign a priority order to information if there are a plurality of information to be provided simultaneously. Alternatively, the navigation system regulates information offering performed by a medium which is considered unnecessary under a predetermined condition. By virtue of the above, the present invention provides a driver with only necessary information.

DEPR:
In general, running conditions (e.g. speed, distance between vehicles, auto cruise state and the like) vary momentarily. In the first embodiment, the mode of information regulation is changed in accordance with the running conditions. Note that information in the multimedia navigation system includes various types, such as urgent information (e.g. accident information) which should not be regulated because of its high urgency characteristic, and non-urgent information such as titles of music programs or the like. The mode of regulating information offer should be determined in accordance with the running condition at which the information is to be provided. Therefore, in the present embodiment, the mode at which information is regulated is changed in accordance with the change in running conditions. Since running conditions vary depending on the driver or roads on which the driver is driving, the running conditions in the present embodiment are classified into seven types as shown in FIG. 5: "vehicle state," "running state," "running environment," "driving purpose," "time zone," "driver's condition" and "information precision." In other words, running conditions are classified into seven types, and maps are set to prescribe modes of information regulation in dependence upon each running condition. Meanwhile, reference items such as those shown in FIG. 5 are displayed to a driver (on the display 8) so that the driver is fully informed of how information offer is regulated upon selection of each map.

DEPR:
FIG. 6 is a table which defines types of information generated in the system according to the first to twelve embodiments and various attributes predeterminedly given to each type of information. As the types of information, the followings are set: "urgent information," "vehicle information," "VICS information," "traffic information," "NAVI information," "weather information," "news," "sports information," "event information" and "music title." The table in FIG. 6 shows definitions in "types KND," "priority order PRD," "priority rank (default value) RKD," "priority rank (corrected) RKC," "capacity (default value) CAPD," "capacity (changed value) CAPC," "remaining capacity REM" and "pointer" with respect to each of the various information.

DEPR:
More specifically, an identifier KND indicative of the type of the information is added to each data. For instance, KND=3 is VICS data. Moreover, the "priority order PRD" is set in advance for each data. The value of "priority order PRD" indicates priority at the time of offering the data. For instance, an identifier KND=3 is assigned to data inputted from VICS medium, and the value of the priority order PR is 3. Lower number indicates higher priority. KND=1 indicative of the highest priority is given to "urgent information" such as data informing that a vehicle is on fire or accident in a tunnel or the like. The "priority order PRD" shown in FIG. 6 indicates default values which can be changed by an operator performing predetermined operation. The priority order PRC changed by an operator is stored in PRC in the table in FIG. 6.

DEPR:
FIG. 9 shows a list of input information and data to be outputted which construct a queue table. More specifically, the table shows the list of stored information which has been inputted by a certain time t3. FIG. 9 indicates that data=X indicative of vehicle information (KND=2) is inputted at time t1; data=Y indicative of traffic information (KND=4) is inputted at time t2; and data=Z

indicative of urgent information (KND=1) is inputted at time t3. When next data is inputted, the data is stored in a position in the table indicated by the pointer r.

DEPR:
The table in FIG. 13, showing lower limit values of priority, is referred when there is information to be provided as audio information, and defines the relationship between the running state STAT of a vehicle at the time of providing information and the lower limit value RKLMT which regulates the priority rank RKC of the information.

DEPR:
For instance, it is assumed herein that input information (X, Y, Z) as shown in FIG. 9 is stored in a memory to be provided as audio information. When the current vehicle is in the state of abrupt break, the lower limit value RKLMT is A. Therefore, information having the priority higher than rank value A is recognized as the information to be provided to a driver. Thus, the data X and Y whose rank values are B and C respectively are not provided to the driver as audio information.

DEPR:
Meanwhile, when a vehicle is in the state of backing up, the lower limit value RKLMT is C. Therefore, information having the priority higher than rank value C is recognized as the information to be provided to a driver. Thus, all the information X, Y and Z (all data in FIG. 9) whose rank values are respectively A, B and C are provided to the driver as audio information.

DEPR:
When regulating in formation offer in accordance with the priority lower limit RKLMT (degree of priority order), if there are a plurality of information having a higher rank than the priority lower limit RKLMT, priority order cannot be given to these information. Therefore in the first embodiment, for the purpose to assign absolute priority orders to a plurality of information where priority orders cannot be determined by the priority lower limit RKLMT, univocal sequential relationship is given to information offering in accordance with priority order PRC which is allocated univocally to the information type KND.

DEPR:
Note that in order to save the storage area, unnecessary data may be periodically deleted. The unnecessary data is, for instance, data which has been stored for a predetermined period of time, traffic information with regard to a point already passed, title of songs while a driver is not listening to radio and the like.

DEPR:
As set forth above, in the system according to the present embodiment, the data storage drive 5 is not occupied by particular information which occurs frequently despite its importance, because the storage area is set in accordance with types of media, thus types of information. In addition, by allowing a user to designate a storage area, a larger storage area can be allocated to information which is important to the user. Therefore, it is possible to prevent important information from not being stored. Furthermore, on account of the special storage area (free area) allocated to urgent information, urgent information can be received any time.

DEPR:
In step S502 in FIG. 17, an argument x of the subject information is saved in a register n. In step S504, running state STAT of the vehicle is determined. Seven types of running states STAT of a vehicle are assumed in the present embodiment: "abrupt turn," "abrupt break," "back up," "change lane," "turn right/left," "abrupt acceleration" and "normal." In step S506, the lower limit value of priority RKLMT is read out of the table shown in FIG. 13, "definition table of priority lower limit RKLMT" in accordance with the detected running state STAT. In step S508, the priority rank RKC and the lower limit value RKLMT of the requested information data are compared, and in step S520, only the data satisfying RKCn.gtoreq.RKLMT is subjected to consideration for information offer. Therefore, data n which satisfies RKCn
DEPR:
As described above, according to the present invention, when there are a plurality of information to be provided to a driver, appropriate information

(RKC.gtoreq.RKLMT) is selected in accordance with the running state of a vehicle and provided to the driver. As a result, information truly necessary by the driver is selected, so that the aforementioned problem of making the driver feel uncomfortable will be solved.

DEPR:
In the first embodiment, data is discriminated between data necessary to be provided to a driver and data not necessary to be provided to the driver, in accordance with running state as defined in the table in FIG. 13. However if there are a plurality of data, having the same value of the priority rank RKC, simultaneously exist to be provided to a driver, the priority of the data cannot be determined by using only the lower limit value RKLMT. To cope with this situation, in the fist embodiment, an urgent level LVL of output timing is defined based on the priority rank RKC of the data and the current running state STAT, and the data occurred at the same time is mediated based on the level value LVL (=1 to 3).

DEPR:
FIG. 11 shows a table on the logic of generating a level LVL indicative of output timing of the data (i.e. urgent level for output), which is determined on the basis of a priority rank of the data (inputted data or data subjected to output) and the current running states STAT. The level LVL is used to determine the data is to be outputted (information offer) as shown in FIG. 12. More specifically, when data is in an output queue, determination is made, utilizing the level LVL, on the basis of the priority rank RKC of the data and the running state, as to whether the data should be outputted or should be forced to wait. Meanwhile, when data in the output queue is currently being outputted, determination is made, utilizing the level LVL, as to whether to continue or terminate the output operation.

DEPR:
FIG. 12 shows results of control procedure shown in FIG. 18. More specifically, the level LVL is used differently depending on whether or not there is data currently being outputted (referred to as "outputting data" for descriptive convenience) as shown in FIG. 12. In a case where "input data" occurs while there is no "outputting data," the level LVL is used to determine how to process the input data. In a case where there is "outputting data," the level LVL is used to determine whether or not the output operation is to be terminated.

DEPR:
When there is no outputting data, determination NO is made in step S522 in FIG. 18. In step S550, the level LVLn of input data n is obtained. If the value of LVLn is "1," the processing proceeds to step S554 where the input data is outputted. More specifically, an output queue flag OUTQn of the data n is set at "1" in step S554. As a result, input data satisfying level LVLn=1 is output. Input data satisfying the level LVL=1 is, e.g., data having rank "A" in all running states, or data having rank "B" or "C" in the running states of "back up," "change lane," "turn right/left," "abrupt acceleration," and "normal," or data having rank "D" in the running state of "change lane," "turn right/left," "abrupt acceleration," and "normal," or data having rank "E" in the normal running state.

DEPR:
When the level LVLn of input data n is "2," the control steps in FIG. 18 will not be executed. As apparent from FIG. 11, data having level "2" is: data having rank "B," "C" or "D" in the running state of "abrupt turn" "abrupt break" and "route guidance," or data having rank "D" in the running state of "change lane," "back up," or data having rank "E" in the running state of "turn right/left," "abrupt acceleration," and "route guidance." Since data having level "2" is not urgent, e.g. vehicle information and the like during abrupt turn or abrupt break, it is not provided to the driver. Such data is returned from step S552 in FIG. 18 to the initial routine to postpone the output. Note that the postponed data, e.g. "vehicle information," is released from the standby state and outputted (if there is no other data) when the vehicle state changes from, for instance, "abrupt break" to "change lane."

DEPR:
Meanwhile, when the level LVLn of the input data n is "3," the processing proceeds to step S560 in FIG. 18. Data having level "3" is: data having rank "E"

in the running state of "abrupt turn," "abrupt break" and "back up." Since such data is not urgent, information offer is prohibited and data is cleared. That is, in step S560 in FIG. 18, the queue flag IQn of the subject information n is reset (also deleted from the queue table in FIG. 9), and audio information is cleared in step S562. In step S564, a message informing a driver that audio information is cleared, is displayed on the display 8.

DEPR:
In a case where there is outputting data (determination YES is made in step S522), the processing proceeds to step S524 where an argument x of the outputting data is saved in the register k. In step S526, a value of the level LVLk of the outputting data is obtained.

DEPR:
If the value of LVLk of the outputting data is "1" in step S528, the processing returns to the initial routine. In other words, if the level of the outputting data is "1," outputting operation of the outputting data is continued, but inputted data is not offered to the driver and is postponed. Herein, outputting data having LVLn "1" is data having rank "A" in the running state of "abrupt turn," "abrupt break" and "route guidance," or data having rank "C" or higher in the running state of "back up," or data having rank "D" or higher in the running state of "change lane," "turn right/left," and "abrupt acceleration," or data having all ranks in the normal running state. As explained above, outputting data having level "1" is urgent information or information which does not disturb the driver in any running states. Thus, output operation therefor is continued.

DEPR:
Herein, a problem arises if input data having rank "A" (e.g. urgent information) is inputted while the outputting data having level LVL "1" is being outputted. Particularly, it is problematic when the outputting data has rank "B" which is lower than rank "A," because the data having rank "A" may be forced to wait. According to the level setting in FIG. 11, the time at which the input data having rank "A" is forced to wait is when the outputting data having rank "B" is being outputted in the running state which is not "abrupt turn" or "abrupt break." Therefore, even if inputted data having rank "A" is forced to wait in the running state other than the "abrupt turn" or "abrupt break," it would not cause any problem. Furthermore, in the first embodiment, inputted data having ranks other than rank "A" is not processed to be outputted during "abrupt turn," or "abrupt break" by virtue of the operation in step S508 (FIG. 17). Accordingly, in the first embodiment, such situation where data having rank "B" or lower is outputted before outputting data having rank "A" during the running state of "abrupt turn" or "abrupt break" would not occur.

DEPR:
In a case where determination is made in step S528 in FIG. 18 that the outputting data has level "2," a flag OUTPk is reset in step S530 to cancel the output of the outputting data. In step S532, the flag IQk is set at "1" to make the outputting data k in output-waiting state. The data whose output has been terminated is next outputted when the running state which has caused the termination changes.

DEPR:
Herein, outputting data having level "2" is: data having rank "D" or higher in the running state of "abrupt turn," "abrupt break" and "route guidance," or data having rank "D" or higher in the running state of "back up," or data having rank "E" in the running state of "change lane," "turn right/left," "abrupt acceleration," and "route guidance." It is not problematic if outputting of data having level "2" is terminated since it is not urgent.

DEPR:
FIG. 28 shows the state where output operation of data k which is outputted during the running state of abrupt turn, is terminated by another inputted data n which causes to change the urgent level to LVL=2, and is resumed after the running state returns to normal.

DEPR:
Meanwhile, referring back to FIG. 18, if determination is made in step S528 that outputting data has level "3," the processing proceeds to step S540 where the flag OUTPk of the outputting data k is reset to terminate the output operation.

Further in step S542, the subject information is cleared, thus will not be outputted in the future. In step S546, a message indicating that the data has been cleared is displayed on the display 8 to inform the driver.

DEPR:
As has been described above, in accordance with a priority rank, running state or conflicting state of information, inputted data is returned to the output queue (OUTQ=1), or output operation of data currently being outputted is terminated and the data is returned to the output queue. In the case where the data being outputted is returned to the output queue, the data is outputted to a driver in output routine in step S600 in FIG. 10 (details shown in FIG. 19). More specifically, data in the output queue is read in step S602 in FIG. 19. The identification of the information in the output queue is stored in the register x. In step S604, the number of times of continuous data output is obtained. Details thereof will be described later.

DEPR:
If the number of times of the continuous data output is within a limited value, it is confirmed in step S606 that there is no other data being queued as output data, and in steps S608 and S610, subject information x is marked m as outputted data (OUTPm=1). Then audio information is outputted-in step S612 to a digital signal processor (DSP) (not shown) in the centralized control unit 2 to be output as audio information. In step S614, output starting time (TMST) of the data is stored in a register. The processing returns from step S614 to the main routine in step S700 (FIG. 10).

DEPR:
Upon completing audio information output via the DSP, the completion is detected as an interruption. When output-complete interruption is detected, the control steps shown in FIG. 20 begins. It is confirmed in step S802 in FIG. 20 that there is at least one entry in the queue being outputted. In step S804, the data number in the queue being outputted is stored in the register q. In step S806, the output queue (OUTP) is reset to indicate that output has been completed. In step S808, the time at which the output has been completed (TMED) is stored in a register.

DEPR:
Herein, the routine in FIG. 19 for obtaining the number of times will be described.

DEPR:
When data, particularly audio information, is continuously output, a driver is bothered by such information. Therefore, it is preferable to reduce an excessive amount of audio information provided to a driver in a continuous manner. However, the number of times of continuous information offering should be regulated in accordance with running conditions. Therefore, in the present embodiment, limitation in number of times LMT of continuous output is defined as shown in FIG. 21.

DEPR:
A driver feels that data is "continuously outputted," when the time difference between output-completed time (=TMED) of data and output starting time (=TMST) of the next data is small. Assuming that a threshold value of the time difference is set to a predetermined value .delta., it is defined herein that a driver feels uncomfortable when a sequence of data output satisfying TMST-TMED<.delta. is repeated for the number of times LMT. In the present embodiment, when data is outputted the LMT number of times, data waiting in the output queue is removed from the queue, so that the driver will not be bothered by continuous output of audio information. Note that the limitation in number of times LMT varies in accordance with the running state. Therefore, in the first embodiment, the limitation in number of times LMT is varied in correspondence with the running state as shown in FIG. 21. Since data should not be removed while a vehicle performs urgent operation (abrupt turn or abrupt break), the LMT value is not limited under such condition. On the contrary, under a driving state which is closer to the normal driving condition, a driver drives in free and easy manner. In other words, the driver is more tolerant of information offer. Thus, larger value of LMT is set.

DEPR:

The number of times may be obtained at the time of starting output operation. More specifically, step S604 (details shown in FIG. 22) is executed each time the output routine in FIG. 19 is executed. In step S572 in FIG. 22, TMST-TMED is calculated. In step S574, it is determined whether or not the difference obtained in step S572 is larger than the threshold value .delta.. If it is larger, the system judges that the continuous output so far is not problematic. Then in step S582, a counter CNTR which stores the number of times of continuous output is reset.

DEPR:
Meanwhile, if the difference exceeds the threshold value .delta., the processing proceeds to step S576 where the counter CNTR is incremented. In step S578, the counted value CNTR is compared with the limitation in number of times LMT corresponding to the current running state STAT. If the counted value CNTR exceeds the LMT, a data output request (IQ=1) which is queued in the output table is searched in step S580. Then the queue of data output is reset in step S590.

DEPR:
Furthermore, the urgent level LVL indicative of the timing of data output is determined on the basis of both the running state STAT and priority rank RK of data as shown in the tables in FIGS. 11 and 12. Accordingly, uniform information offer, where data output is determined based on only the running state STAT or only the priority rank RK, is prevented, and well-balanced information offering is realized. This is because the timing at which information is provided to a driver should be determined by taking account of both nature of the information (rank, that is, importance) and current running state (urgent level).

DEPR:
Moreover, by virtue of the fact that continuous data output is limited as shown in FIG. 21, a driver will no longer be bothered by an enormous amount of information being offered. In addition, the limitation in the number of times of continuous output is changed in accordance with the running state. Thus, a situation such as where important information is lost depending on the running state, does not occur.

DEPR:
Hereinafter, description will be provided in the first modified example where modification is added to the controlling operation (FIGS. 10 to 28) of the foregoing first embodiment. According to the first embodiment, when audio information having rank "B" (information related to vehicle) is inputted in the running state of abrupt turn or abrupt break, LVL=2 is given to the data because data having rank "B" is considered as relatively important. Thus, depending on conflicts with other information, the audio information having LVL=2 is provided to the driver.

DEPR:
FIG. 67 is a setting table where urgent levels of output timing are set, which is used in controlling of the first modified example. The table in FIG. 67 differs from the table used in the first embodiment (FIG. 11) in that, as described above, LVL=1 is given to data having rank "B" in the running state of abrupt turn or abrupt break, and the data is offered to the driver always on a display.

DEPR:
The first modified example employs substantially the same control steps described in the first embodiment. However, the routine "processing corresponding to priority" (FIG. 18) in the first embodiment is substituted with control steps shown in FIG. 68. More specifically, in the controlling of the first modified example, when data having level LVL=1 is detected while the data has rank "B" and when the running state of the vehicle is abrupt turn or abrupt break, the inputted data is converted to text data (or kept as text data) to be displayed on the display 8.

DEPR:
Note that in the first modified example, the information having rank "B" (e.g. vehicle information) is regulated so that it is not provided as audio information. However, during the running state of abrupt break or abrupt turn, a driver may feel annoyed even when audio information having rank "A" is provided. To cope with this, the first modified example may be modified further such that audio information having rank "A" is converted to text data to be displayed.

DEPR:
In the above-described first embodiment, the timing of information offer, particularly in a case where two conflicting information are simultaneously inputted, is determined by introducing the concept of the urgent level LVL (FIG. 11). The urgent level LVL is determined on the basis of the priority rank RK and running state STAT as shown in FIG. 11.

DEPR:
FIG. 29 shows a table for determining priority, while taking into account of running environment ENV for each type of information. The priority in the second embodiment indicates a classification of control action which is to be taken after the priority is determined. To be discriminated from the "level LVL" used to determine priority in the first embodiment, the priority in the second embodiment will be referred to as "classification CL" for descriptive convenience. In the second embodiment, three types of running environment are set: a mountain road, neighborhood and a congested road. According to FIG. 29, the same type of information has different levels of importance to a driver depending on a running environment. Thus, depending on the change in running environment, a value of priority, i.e. classification CL, is different. The smaller the value of classification CL, the more the information is important for a driver. For instance, NAVI information has high importance (value "2") in a congested road, but has medium importance (value "3") in a mountain road, and has low importance (value "4") in the neighborhood since a driver is familiar with the area. Note that in the second embodiment, data having the classification value CL "1" is always outputted, but data having classification CL "4" is excluded from output object.

DEPR:
More specifically, by the time the processing in step S700 in FIG. 31 is executed, the number x of the data, subjected to information offer, has been registered in the register n. Thus, in step S700, it is determined before processing data n, whether or not there is data x currently being outputted (for descriptive convenience, will be referred to as "outputting data" as similar to the first embodiment).

DEPR:
Description is now provided for a case where the classification CL of the inputted data n is "3." CL=3 denotes that a level of importance of the inputted data n is relatively low under the current running environment. Therefore, it is not necessary to stop output operation of the current-outputting data k having high priority rank RK. It is even preferable not to output the inputted data n, considering the fact that the priority rank of the outputting data k is higher than that of the inputted data n, and the level of importance of the inputted data n is relatively low under the current running environment. It is preferable not to output the data n because the system can prepare for another important data which may be inputted next. Thus, the input queue flag IQn of the inputted data n is reset in step S722, the data is deleted in step S724, and a message indicating the deletion of the data is displayed in step S726. FIG. 34 illustrates the above description.

DEPR:
When a priority rank RK of outputting data k is lower than inputted data n, output operation of the outputting data k is terminated depending on a condition. Whether or not the output operation is to be resumed is determined in accordance with the running environment. More specifically, when two conflicting data exist, whether or not to stop output operation of current-outputting data is determined in accordance with priority ranks between the conflicting data (step S704). Whether or not to resume the output-operation which has been terminated is determined on the basis of the level of importance (classification CL) of the data, while taking into account of the running environment (steps S708 and S710). When it is determined that the terminated output operation will not be resumed, the data is cleared (step S714).

DEPR:
Meanwhile, when a priority rank RK of outputting data k is higher than inputted data n (step S720), whether or not the inputted data n is to be provided to a driver is determined on the basis of the level of importance (classification CL) of the inputted data n, while taking the running environment into consideration.

In other words, output operation of the outputting data k is maintained, but inputted data n having lower priority rank is regulated in accordance with the level of importance of the inputted data n in the running environment (steps S722-S724).

DEPR:
According to the third embodiment, when there are a plurality of data inputted simultaneously to be provided to a driver, whether or not to provide the driver with the data, and the priority order of information offer are determined in accordance with a running mode.

DEPR:
In the third embodiment, whether or not to provide information, and the priority order of the information offer are determined in accordance with a running mode, that is, a general driving mode (low-to-medium speed) and a highway driving mode. As shown in FIG. 35, priority PR and classification CL corresponding to the running mode are defined to each type of information. More specifically, depending on the running mode, different priority values PR and different classification values CL are given to the same information. For instance, NAVI information has priority PR=3 and classification CL=2 in the general driving mode, but has PR=6 and CL=3 in the highway driving mode. Since a driver is less likely to lose his/her way on a highway, the NAVI information is less necessary while VICS information is necessary on a highway. These settings can be changed by a user as similar to the first embodiment.

DEPR:
The determination logic of the order of information offer is basically the same as that of the second embodiment. Particularly noted herein is a logic of determining whether or not to provide the information to a driver. In a case where priority PR of outputting data k is lower than inputted data n, output operation of the outputting data k may be terminated. Whether or not the terminated output operation will be resumed is determined on the basis of the running mode. In other words, when there are two conflicting information, whether or not to terminate output operation of current-outputting data is determined on the basis of priority of the conflicting information (step S1824 in FIG. 42). Whether or not to resume the terminated output operation is determined on the basis of a level of importance (classification CL) of the information, while taking the running mode into consideration (steps S1828 and S1860). In a case where it is determined that the output operation will not be resumed, the data is cleared (step S1864).

DEPR:
Meanwhile, in a case where priority of the outputting data k is higher than inputted data n (NO in step S1824), whether or not the inputted data n should be provided to a driver is determined on the basis of the level of importance (CL) of the inputted data n, while taking the running mode into consideration. In other words, the output operation of the outputting data k having a higher priority than inputted data n is maintained, while the inputted data n having lower priority than data k is regulated in accordance with the level of importance of the inputted data n in the current running mode (steps S1834-S1838).

DEPR:
The third modified example determines the order of information offer and whether or not to provide the information to a driver in accordance with the time zone where driven.

DEPR:
FIG. 48 shows a definition table of priority PR and classification CL as similar to FIG. 35 described in the third embodiment. Values of the priority PR and classification CL are defined (but can be changed) for each type of information as similar to the third embodiment. Even for the same information, different values of priority PR and classification CL are given depending on difference in time zone.

DEPR:
According to the third modified example, the time zone may be designated by the name (e.g. meal hour, commuter's rush hour etc.) as shown in FIG. 48, or by specifying the time as shown in FIG. 49.

DEPR:
The fourth modified example is a modified version of the third modified example, and the determination process of whether or not to provide information to a driver, is further improved. According to the foregoing third modified example, data which is excluded from the determining operation of information offer is predetermined (indicated by "x" in FIGS. 48 and 49) in the system, and the setting can be changed by a user via the display. However, information subjected to processing is different in accordance with the time zone. Therefore, the fourth modified example includes a table shown in FIG. 50. In the table, information are determined in advance as excluded from the determining operation of whether or not to provide a driver, by the driver, and the determination is made in accordance with the time zones.

DEPR:
More specifically, upon executing step S1806, driving time is read and the driving time zone is determined based on the time. Examples of the determination logic are shown in FIG. 52. By utilizing the logic, the current driving time zone can be determined without requiring additional user operation. Upon determining the driving time zone, data to be excluded from the determination operation of whether or not to offer information, is decided by the logic shown in FIG. 50. Note that in FIG. 50, information without the indication .smallcircle. is the data to be excluded.

DEPR:
The control operation performed by the fifth embodiment utilizes the same control described in the third embodiment. FIG. 56 is a table where levels of importance (priority PR and classification CL) of each type of information are defined in accordance with driver's mental state. The table in FIG. 56 is utilized in the fifth embodiment in the manner similar to the way the table in FIG. 35 is utilized in the third embodiment to perform controlling in accordance with running state. More specifically, for the control steps of the fifth embodiment, step S1806 in the flowchart in FIG. 38 is changed to step S1806' as shown in FIG. 58. In step S1806', the table in FIG. 56 is referred to. Note that in the fifth embodiment, the system determines the mental state of the driver on the basis of continuous driving time, the driving time zone, the number of times of breaking and driving speed and so on.

DEPR:
In the control performed by the third embodiment, so called "urgent information" is processed as exceptional data in the routine "processing exceptional data" (FIG. 38), so that the urgent information is quickly and surely provided to a driver. However, such "urgent information" in the third embodiment is data which has been predetermined by the system. Examples of "urgent information" are: tunnel information, earthquake information, vehicle information (alarm for breakdown, alarm for distance between vehicles, alarm for flat tire and the like), traffic information (accident information, regulation of traffic) and the like. Thus, "urgent information" is fixed. The sixth embodiment is characterized in that the "urgent information" can be designated by a driver.

DEPR:
As described above, sixth embodiment handles information designated by a user as "urgent information" in addition to the innate "urgent information." As modified example of the sixth embodiment, for instance, the following process may be performed. That is, difference is calculated between the priority order of the innate urgent information and the priority order of information in question. If the difference is less than a predetermined value (e.g. 2), the information in question is forcibly set as "urgent", as shown in FIG. 77.

DEPR:
Control performed by the seventh embodiment utilizes most of the control steps of the third embodiment. FIG. 62 shows only the steps different from the control steps of the third embodiment. By adding the control step S2000 (FIG. 62) between steps S1804 and S1806 (FIG. 38), the control operation of the seventh embodiment is realized. By such control steps, the system according to the seventh embodiment performs, in step S2000, correction of the priority order which satisfies the rules in FIG. 61, on the basis of various data read in step S1804 (FIG. 38). In step S1806, classification value CL and the limitation in number of times of continuous output LMT are read in addition to the priority PR corrected

in step S2000. Then in step S1810, the routine "processing corresponding to priority" is performed in accordance with the correction value.

DEPR:
Conditions of correction in FIG. 61 are as follows: correction to raise the priority order of vehicle trouble information in a case where a problem suddenly occurs in the vehicle, correction to raise the priority order of VICS information while driving a highway, correction to raise the priority order of weather information while driving a mountain road (detected by a barometer) or driving in rain (detected by wiper being activated), correction to lower the priority order of information having high-level noise or information which has passed for a long time since the time of input, correction to lower the priority order of VICS information related to directions different from destination, and the like.

DEPR:
More specifically, during route guidance, the navigation controller of the navigation system notifies the driver each time the vehicle approaches one of plural route guidance points, so that a driver is able to confirm that he/she is correctly heading toward the destination. In other words, the driver expects to receive some amount of information near the route guidance points. However, in locations other than the route guidance points, the driver does not expect any information, thus feels uncomfortable when provided with excessive amount of information.

DEPR:
To cope with such situation, the navigation controller 17 according to the seventh embodiment sends NAVI information to the centralized control unit of the seventh embodiment in accordance with the control steps shown in FIG. 78, while adding a priority order to the NAVI information. As shown in FIG. 78, the NAVI controller 17 confirms whether or not route guidance control is being performed. If the route guidance control is performed while the vehicle is near (within a radius of a predetermined distance) one of the route guidance points, the priority order of the NAVI information is raised.

DEPR:
Meanwhile, with respect to other information sent by a medium besides NAVI information, if the route guidance control is performed while the vehicle is near one of the route guidance points, the priority order of the information, e.g. news or the like, may be lowered.

DEPR:
Accordingly, NAVI information is prioritized when a vehicle is near the route guidance point, and priority orders of information other than NAVI information are lowered. Therefore, information truly necessary for a driver is provided.

DEPR:
Depending on running speed of a vehicle, information such as traffic information or the like may be inputted many times while driving a short distance. Such repetition of input may bother a driver.

DEPR:
To cope with such situation, the seventh modified example lowers the priority order of data which has the same contents as that of already-inputted data. As a result, a situation where the same information is repeatedly offered to a driver, is prevented. The seventh modified example is particularly effective for data transmitted in the form of character or text because such data is relatively easy to make determination of its contents. By lowering the priority order of the character data or text data having outdated contents, probability of such data being provided to a driver (on a display or as audio information) will relatively decrease. Furthermore, since the multimedia navigation system outputs character data by converting the data into audio information, restraining such outdated information from being displayed or being outputted as audio information, will reduce the driver's uncomfortable feeling.

DEPR:
The seventh modified example also employs a part of the control steps of the third embodiment. More specifically, control steps shown in FIG. 64 is added between the steps S1804 and S1806 of the control steps shown in FIG. 38. In addition, a storage area as shown in FIG. 63 is prepared in the seventh modified

example. In the storage area, time at which character data is inputted, the number of times the data is determined to have the same contents, and the contents of the data are stored.

DEPR:
It is determined in step S2002 in FIG. 64 whether or not inputted data is character data. If the inputted data is not character data, the inputted data will not be subjected to determination of whether or not it is outdated. If the inputted data is character data, it is determined in step S2004 whether or not the storage area in FIG. 63 includes data having the same contents as that of the inputted data. If the storage area does not have any data having the same contents, the inputted data is stored in the storage area in FIG. 63. If data having the same contents is found, the time difference is calculated in step S2008. If the time difference is smaller than a predetermined threshold value .DELTA., it is determined that data having the same contents has been received in a short period of time. Therefore, the priority order of the data is lowered in step S2012. Meanwhile, if the time difference is larger than the predetermined threshold value .DELTA., it is determined that a long period of time has passed since last received the data. Therefore, the data is deleted from the storage area shown in FIG. 63.

DEPR:
Note that in a case where data having the same contents is inputted for the second time, the data may be displayed on the display 8. Further, when the same data is inputted for the third time, the data may be deleted.

DEPR:
In a case where audio information is frequently provided to a driver, the interval of audio information output is also an important factor of driver's concern. Thus, the system according to the ninth embodiment controls the interval of information offer. According to the present embodiment, a long interval of information offer is set for conditions (running environment, running state, driving time, mental state) where a small amount of information offer is preferable, and a short interval of information offer is set for the conditions (running environment, running state, driving time, mental state) where a large amount of information offer is preferable. By virtue of the above, the amount of information offer is controlled to a most appropriate amount in a unit of time.

DEPR:
Referring to FIG. 70, time T denotes the time interval (minimum value) of information offer which is most appropriate for a driver in the current condition. The beginning of the time interval of time T is the output-completed time (TMED) of the previous data. Therefore, the driver will not feel uncomfortable if the next data is provided after the lapse of TMED+T.

DEPR:
Generally speaking, the time interval should be shortened as the vehicle speed rises. However, in a case the vehicle safely runs on a highway, even though the vehicle speed is high, it would not be so problematic to provide a large amount of information. Thus as shown in FIG. 71A, the value of t0 is set small when the vehicle speed is above 80 km/h.

DEPR:
Referring to FIG. 71F, the correction coefficient t5 is set as a larger value as the limitation LMT in number of times of continuous data output (see FIG. 21) becomes larger. As apparent from FIG. 21, the limitation in number of times LMT is set as a smaller value as the driving condition requires more operation to the driver. The more the driving state is close to the normal state, the less information may be provided.

DEPR:
As explained with reference to FIG. 70, when output of the previous data is completed, a delayed time T (interval of information offer) is calculated in step S2210 in FIG. 73 in accordance with FIGS. 71A to 71F. In step S2212, the time T is set at a timer.

DEPR:
Then, when audio information (e.g. data k) is inputted, the determination control of whether or not information is to be offered to a driver and the priority order

of information offer, described with reference to the first to eighth embodiments, is performed. Then, an output queue (OUTQk=1) is set for the audio information k (e.g. step S554 in FIG. 18). Referring to the "output" routine in FIG. 72, it is determined in step S2200 whether the audio information k is urgent information (KND=1) or whether the current position is near a route guidance point (e.g. junction) of the navigation system. This is because output of urgent information (KND=1) should not be delayed, and because the driver necessitates a larger amount of information near a route guidance point.

DEPR:
In a case where the audio information k is not urgent information and the current position is not near a route guidance point of the navigation system, it is determined in step S2202 whether the time set at the timer in step S2212 (FIG. 73) is up. If the set time has not passed, it is too early to offer the audio information k to the driver. Therefore, the output queue of the audio information k is reset (OUTQk=0) in step S2204. By resetting the queue of the audio information k, the system becomes available to output another data having higher priority which may be inputted next.

DEPR:
In the ninth embodiment, the timer T is started each time output of the previous audio information is completed. According to the eighth modified example, the timer T is started each time the output of the previous audio information is started. In this case, the time necessary to output audio information needs to be calculated as shown in FIG. 74.

DEPR:
FIG. 75 shows as an example a display screen of a user interface where the form of audio information output is set. In the tenth embodiment, sound quality and volume are set according to types of guidance information: "warning information," "route guide information," "traffic information," "facility guide information," "highway guide information," "current position information," "running environment," "driving time," "driving time zone" and "driving area." With respect to a type of information which requires driver's attention, tense voice is set and information is provided in a tone of command. On the other hand, in a driving condition where the driver should be relaxed, for instance, soft female voice is set and information is provided in a tone of guidance.

DEPR:
FIG. 80 is a logic table ("table for determining audio information output destination") for determining the medium to which audio information is to be outputted on the basis of the "urgent level" which is determined based on the running state and conditions, and the "priority rank RK" of the data itself. The eleventh embodiment is characterized in that a user is able to select the determination logic. FIG. 79 is a table ("definition table of menu-setting permission") defining the areas where a user is allowed to take part in determination.

DEPR:
Hereinafter, the urgent level in the eleventh embodiment will be described.

DEPR:
The urgent level is, as similar to the foregoing embodiments, an index to express a level of urgency of information based on various aspects other than the information itself. In the present embodiment, the urgent level is defined as shown in the table in FIG. 81. It is defined that the smaller the value of the urgent level, the higher the urgency. Note that most states shown in FIG. 81 are determined by various sensors shown in FIG. 2. For instance, "prediction of large curvature on the road" in the first column of the table in FIG. 81 can be determined on the basis of information sent by the NAVI controller, e.g. information notifying that the vehicle is approaching a curve.

DEPR:
Referring to the table in FIG. 80, the sign X denotes that information is not offered. According to the "table for determining audio information output destination" in FIG. 80, the lower the priority rank RK (indicative of urgency of data itself) is, and the higher the urgent level as a running state (vertical column of the table in FIG. 80) is, the necessity to provide such data is low. Thus, such data is not provided to the driver as audio information or not

displayed on a display. For instance, when priority rank RK=E and urgent level LVL=1, data is not outputted. On the other hand, the higher the priority rank RK of data itself is, and the lower the urgent level as a running state is, the necessity to provide such data is high. Therefore, such audio information has a wider selection for output destination. For instance, when priority rank RK=A or B and urgent level LVL=4, the data can be outputted as audio information or displayed on a display (display 8 or head-up display).

DEPR:
As set forth above, the output destination of audio information is selected in accordance with running state of a vehicle. Accordingly, appropriate information can be provided to a driver in appropriate timing.

DEPR:
For the descriptive convenience for describing the operation of the twelfth embodiment, it is assumed herein that the navigation system of the twelfth embodiment receives the following types of information: "warning information," "route guide information," "facility guide information," "highway guide information," "traffic information" and "current position information." These information are "guide information" for the driver. Environment conditions which become the base of these information is detected by various environment detecting means exemplified in FIG. 83. When warning indicative of a small amount of remaining fuel is issued, what the driver needs is a series of guide information to deal with the warning. FIG. 84 shows examples of such guide information. In other words, it is preferable for the driver to be provided with the guide information in a logical series of sequence to deal with the warning. More specifically, if facility guide information is provided before warning information, the driver must take time to figure out why the facility guide information is being offered. It is difficult for the driver to think such matter while driving. In the navigation system of the twelfth embodiment, the order of information offer is designated by using a user interface shown in FIG. 85. In FIG. 85, the priority order of information offer is specified by a user. Thus, the designation of information offering order designated by a user can be applied to the navigation system of the aforementioned first to eleventh embodiments since all the navigation systems utilize the "priority order." While the navigation systems according to the first to eleventh embodiments determine the priority order on the basis of a level of importance or a level of urgency, the system of the twelfth embodiment determines the priority order such that a sequence of information offer makes sense to the driver.

DEPL:
Herein, the time t0 is the basic value of information offer interval which is determined according to vehicle speed.

DEPC:
Third Modified Example (Considering Time Zone)

DEPC:
Fourth Modified Example (Considering Time Zone)

DEPU:
C: Occurrence of facility guide information is determined by whether the vehicle runs near a destination point or route guidance point while route guidance is being provided;

DEPU:
D: Occurrence of highway guide information is determined by whether or not the vehicle is running on highway;

DEPU:
E: Occurrence of traffic information is determined by whether or not there is congestion or accident on the road the vehicle is running;

DEPU:
F: Occurrence of current position information is determined by whether or not the vehicle is running an area where driving frequency is low.

DEPV:
"-1: Information offered to a driver is regulated by not providing information

having low priority (regulating data output by RKLMT shown in FIG. 13, or prohibiting output of data having level 3 as shown in FIG. 12).

CLPR:
4. The navigation apparatus according to claim 1, wherein the priority order is prescribed in accordance with a running state of a vehicle.

CLPR:
5. The navigation apparatus according to claim 4, wherein the priority order is changed in accordance with change in the running state of a vehicle.

CLPR:
6. The navigation apparatus according to claim 4, wherein the priority order is prescribed in accordance with running environment of a vehicle.

CLPR:
7. The navigation apparatus according to claim 6, wherein the priority order is changed in accordance with change in running environment of a vehicle.

CLPR:
17. The navigation apparatus according to claim 1, wherein the running state is inclusive of a driving time zone during which the driver is driving, and said allocating means sets the priority order and travelling classification of inputted information to a value according to the driving time zone.

CLPV:
means for allocating, to inputted information, a rank indicating a type of the inputted information, and a priority order indicating a priority degree of the inputted information;

CLPV:
means for setting an urgency level indicating a degree of urgency of the inputted information with respect to travelling, the urgency level being set to either one of a highest first, intermediate second and lowest third values in consideration of the allocated rank and at least one of running state, driving purpose and running environment; and

CLPV:
control means for allowing a provision of the inputted information suspending the provision of the inputted information until the provision is allowed, and canceling the provision of the inputted information when the set urgency level indicates the highest first, intermediate second and lowest third values, respectively.

CLPV:
means for detecting a time interval between the audio information successively provided by said providing means;

CLPV:
restraining means, operatively connected to said detecting means and said providing means, for restraining said providing means from providing the audio information successively, if it is detected that a predetermined number of conditions have successively occurred in the time interval less than a predetermined time length.

CLPV:
means for allocating a priority order to inputted information in accordance with a type of the inputted information, the priority order being prescribed in accordance with a quality of information;

CLPV:
means for providing the driver with the selected information in accordance with a priority order of the selected type of information,

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DB Name	Query	Hit Count	Set Name
USPT,PGPB,JPAB,EPAB,DWPI,TDBD	l3 and level	112	L7
USPT,PGPB,JPAB,EPAB,DWPI,TDBD	l3 and (urgency and danger)	0	L6
USPT,PGPB,JPAB,EPAB,DWPI,TDBD	l3 and (urgency same danger)	0	L5
USPT,PGPB,JPAB,EPAB,DWPI,TDBD	l3 and (urgency near danger)	0	L4
USPT,PGPB,JPAB,EPAB,DWPI,TDBD	l2 and tim$3	137	L3
USPT,PGPB,JPAB,EPAB,DWPI,TDBD	l1 and (vehicle or automobile or aircraft or aerodyne or boat or car)	156	L2
USPT,PGPB,JPAB,EPAB,DWPI,TDBD	(hierarchy or priority order) near (information or data)	2076	L1